Extended-Range Impact Weapon

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Definition

An extended-range impact weapon (ERIW) is a dedicated launcher system used to fire kinetic projectiles intended to produce pain, temporary incapacitation, or behavioural compliance through blunt-force impact while reducing the probability of death or serious injury relative to conventional firearm ammunition.

This category includes:

- 37 mm launchers;
- 40 mm launchers;
- ARWEN-type platforms;
- sponge rounds;
- foam-tipped plastic projectiles;
- rubber baton rounds;
- plastic baton rounds; and
- comparable single-projectile kinetic impact munitions fired from dedicated launchers.

It excludes 12-gauge beanbag or flexible impact rounds, classified separately as Less-Lethal Shotgun; PepperBall, FN 303, or similar chemical/kinetic systems, classified as Extended-Range Chemical Weapons; and conventional firearm ammunition.

This definition corresponds with the research dataset, where `I_ERIW` is coded when an officer discharges a 37 mm, 40 mm, ARWEN, or similar dedicated launcher firing a blunt-force impact projectile.

How It Is Designed to Work

Extended-range impact weapons operate by transferring kinetic energy from a launched projectile into the body. The intended effects may include intense localized pain, temporary motor dysfunction, interruption of aggressive behaviour, loss of balance, distraction, temporary inhibition of movement, or sufficient physical disruption to permit officers to approach and restrain the person. Unlike conventional firearm ammunition, ERIW projectiles are generally designed to reduce penetration by using larger projectile diameter, deformable or compressible materials, foam or sponge noses, lower projectile velocity, increased impact surface area, or combinations of these features.

The underlying engineering problem is the same as for other kinetic less-lethal weapons: the projectile must deliver enough energy to change behaviour without delivering so much energy, or concentrating that energy

so narrowly, that it produces catastrophic trauma. That margin is not fixed. Injury severity depends on projectile design, projectile mass, velocity, firing distance, anatomical target, impact angle, subject movement, clothing, bone and tissue depth, and whether the projectile behaves as designed at impact.

ERIW Is Not a Single Homogeneous Technology

The ERIW category contains weapons with substantially different projectile designs and historical risk profiles. A modern 40 mm sponge or foam-tipped round is not mechanically identical to an older solid plastic baton round, a rubber-coated or rubber projectile, a wooden baton round, a multiple-projectile rubber system, or a shotgun-fired beanbag. This distinction matters scientifically: the broader kinetic-impact literature is useful for identifying mechanisms of injury and high-risk conditions, but findings from older Northern Irish plastic-bullet systems should not automatically be interpreted as exact injury probabilities for contemporary 40 mm sponge rounds; evidence in this library should therefore be read at two levels: platform-specific evidence, when a study identifies a modern 37/40 mm or comparable projectile, and class-level kinetic-impact evidence, when the study combines multiple projectile types.

Evidence of Effectiveness

Overall assessment

The ERIW literature has the same fundamental imbalance seen with less-lethal shotguns. There is substantial evidence describing what injuries kinetic projectiles can cause, which anatomical regions are especially dangerous, how firing distance affects risk, and how severe outcomes occur. There is much less peer-reviewed evidence answering how often a modern 37 mm or 40 mm impact projectile successfully stops threatening behaviour without requiring additional force – a gap that should be understood as a substantive finding rather than merely an absence of data. The evidence is low-to-moderate for operational effectiveness but moderate-to-strong for injury mechanism and serious-harm potential.

Operational effectiveness

Kobayashi and Mellen [(Kobayashi & Mellen, 2009)] provide a particularly useful example of the distinction between impact and incapacitation. The case involved a 30 g projectile with a 40 mm sponge-foam nose and plastic body; the projectile caused pulmonary contusion but did not incapacitate the subject, who later died from a self-inflicted firearm injury unrelated to the projectile. This case is important because it directly illustrates the central design problem: an impact can be medically significant without being behaviourally effective. That finding should not be generalized into a failure rate, because it is a single case, but it does demonstrate why a simple hit/miss measure is insufficient for ERIW effectiveness.

Tactical value

The principal operational advantage of ERIW systems is distance. Compared with a baton, handheld chemical spray, or hands-on control, a dedicated launcher allows officers to attempt force while maintaining greater separation from the subject. Potential tactical benefits include reducing the need for close physical contact, interrupting dangerous behaviour from behind cover, allowing a planned arrest team to move after successful impact, attempting lower-lethality intervention while lethal-force officers provide cover, and providing a more accurately aimed single-projectile option than some older crowd-control munitions. Distance alone does not establish effectiveness, however: the weapon remains dependent on accurate placement, sufficient kinetic effect, subject response, tactical containment, and the ability to manage a failed deployment.

What is missing

The peer-reviewed literature does not currently provide a reliable, generalizable estimate for first-round incapacitation, overall encounter-resolution success, average number of rounds required, probability of avoiding firearm use, probability of avoiding officer injury, failure rate against armed subjects, comparative effectiveness of 40 mm versus CEW or OC, comparative effectiveness of 40 mm versus less-lethal shotgun, or success specifically in edged-weapon confrontations. Manufacturer specifications, training reports, agency after-action documents, and individual success stories may help describe how these systems are intended to perform, but they should not be substituted for independent denominator-based outcome research.

Injury and Safety Evidence

Systematic evidence on kinetic impact projectiles

Haar and colleagues (Haar et al., 2017) conducted the most important broad systematic review of kinetic impact projectile injuries. The review included 26 studies and 1,984 injured people, among whom 53 died and 300 suffered permanent disability. The authors found that 49.1% of deaths resulted from impacts to the head or neck, and 82.6% of permanent disabilities followed head or neck strikes; among surviving patients, 71% of reported injuries were classified as severe. The review also identified anatomical impact site, firing distance, and timely access to medical care as important determinants of injury severity.

These figures must not be interpreted as the probability of death or disability per ERIW deployment. The source studies overwhelmingly sampled injured people rather than all persons exposed to kinetic projectiles. The review therefore establishes the severity and mechanisms of possible harm, not a deployment-level risk denominator.

Modern 40 mm evidence

Kobayashi and Mellen (Kobayashi & Mellen, 2009) described a modern-style projectile consisting of a 40 mm sponge-foam nose and plastic body that caused pulmonary contusion. Although the subject was not incapacitated and died from a separate self-inflicted gunshot wound, the case demonstrates that a foam-nosed projectile can

still transmit enough energy to injure the thorax. This is particularly relevant because modern sponge-round design is intended to reduce the penetration and severe-trauma problems associated with older solid plastic or rubber munitions: risk is reduced, not eliminated.

Civil-unrest injury series

Suyama and colleagues (Suyama et al., 2003) examined injuries during a period of civil unrest in Cincinnati, where police used several less-lethal impact systems including square shotgun-fired beanbags, stabilized round beanbags, and large foam projectiles fired from 40 mm launchers. Among 25 included patients, 7 (28%) had significant morbidity, with documented serious injuries including pulmonary contusion, liver laceration, Achilles tendon rupture, delayed pneumonia, and post-concussive syndrome. There were no fatalities in the case series. Again, this does not establish a 28% injury rate per projectile deployment, because the study captured only people who presented for emergency medical care.

Historical plastic-baton-round evidence

Ritchie (Ritchie, 1992) reported 123 patients with 126 plastic-bullet injuries over a 14-year period in Belfast, finding one death and several serious injuries, with serious injury or death significantly associated with impact above the diaphragm. This historical literature is highly relevant to anatomical-risk principles but should not be interpreted as an exact proxy for modern foam-tipped 40 mm rounds.

Historical mortality and misuse

Metress and Metress (Metress & Metress, 1987) reviewed plastic-bullet use in Northern Ireland, documenting 13 deaths associated with plastic bullets – including seven children – along with serious permanent injuries. Their analysis emphasized that many fatal shots were fired from distances shorter than those considered safe and in ways inconsistent with applicable rules of engagement. This is important for the evidence library because it shows that policy compliance is part of the safety system: a projectile designed for reduced lethality can become substantially more dangerous when used too close, at prohibited anatomical targets, outside intended operating conditions, or in ways inconsistent with training.

Comparative Injury Evidence

Petersen and colleagues (Petersen et al., 2025) analyzed 2,348 police use-of-force incidents from 17 large urban and metropolitan agencies. After adjustment for officer, civilian, and situational characteristics, impact weapons were predicted to result in hospitalization or death in approximately 16% of cases – higher than chemical agents at approximately 4% and conducted energy devices at approximately 13%, but lower than police canines at approximately 37%. This finding is useful but must be interpreted cautiously, because the study's impact-weapons category is broader than modern ERIW alone and may include other impact modalities. It therefore supports a general conclusion that impact force carries meaningful injury risk, but it does not provide a clean 40 mm-specific probability.

Bozeman and colleagues (Bozeman et al., 2018) prospectively examined 893 police use-of-force incidents with physician review of injury severity. Only eight kinetic impact munition uses occurred in the cohort – too few to produce a stable ERIW-specific injury estimate – but the study is valuable because it demonstrates how rarely these munitions may appear relative to physical force or CEWs in routine policing datasets.

Anatomical Location Matters

Anatomical impact location is one of the strongest and most consistent predictors of serious injury. High-risk areas include the head, eye, face, neck, throat, chest, precordium, spine, abdomen, and groin. The evidence from Haar et al. (Haar et al., 2017), Ritchie (Ritchie, 1992), and Metress and Metress (Metress & Metress, 1987) strongly supports avoiding the head and neck except where force capable of causing serious bodily injury or death would otherwise be legally justified. The risk gradient is not subtle: a lower-extremity strike and a head strike from the same launcher should not be treated as equivalent force merely because both use a less-lethal projectile.

Above-the-diaphragm risk

Ritchie (Ritchie, 1992) specifically found a significant association between serious injury or death and impacts above the diaphragm. Although modern projectile designs differ from the plastic rounds in that study, the anatomical principle remains relevant because the thorax contains the heart, lungs, major vessels, and relatively little tissue over some vulnerable structures. A foam projectile can reduce concentrated energy transfer without eliminating the possibility of pulmonary or cardiac injury.

Distance Matters

Firing distance affects both safety and effectiveness. At shorter distances, the projectile may retain more kinetic energy, deform less effectively, concentrate energy over a smaller area, and increase the probability of severe blunt or penetrating trauma. At longer distances, it may lose energy, lose accuracy, strike an unintended anatomical area, or fail to generate sufficient behavioural effect. Haar et al. (Haar et al., 2017) identified firing distance as a factor associated with injury severity, and Metress and Metress (Metress & Metress, 1987) likewise documented fatal cases involving firing distances shorter than prescribed. The weapon has an intended operating envelope, and using it outside that envelope can make it either more dangerous or less effective.

Accuracy and Projectile Design

Accuracy is not merely an effectiveness issue. It is a safety issue because unintended target placement can convert a planned lower-risk extremity strike into ocular trauma, head injury, cervical injury, chest injury, or abdominal trauma. Older kinetic projectiles have been criticized for poor accuracy and unpredictable flight. Modern single-projectile systems are designed to improve point-of-aim/point-of-impact performance, but

subject movement and real-world conditions still matter. Relevant factors include projectile aerodynamics, range, officer movement, subject movement, low light, stress, partial obstruction, clothing, and changing body orientation. The safety advantage of a more accurate projectile depends on officers actually being able to place it on a lower-risk anatomical target.

When Its Use May Be Appropriate

The scientific literature does not define a universal deployment threshold, but the evidence supports several broad principles. An ERIW is most defensible where a person presents a significant threat requiring physical intervention, officers can maintain sufficient distance and cover, the threat does not require immediate firearm-level stopping reliability, officers have time to aim at an appropriate lower-risk target zone, a failed deployment can be safely managed, hands-on intervention would expose officers to substantial risk, and the projectile may reasonably prevent escalation to lethal force. Potentially appropriate circumstances include a dangerous but contained subject holding a weapon without actively attacking, an armed suicidal person where officers have cover, time, and lethal-force backup, violent resistance occurring beyond safe hands-on distance, an individual attempting to arm themselves where a planned impact may interrupt the behaviour, or a tactically controlled encounter where officers can immediately transition to another option if the projectile fails. The strongest operational model is generally planned less-lethal deployment supported by cover, containment, communication, and lethal-force backup when appropriate.

When Its Use May Be Inappropriate

Low-level resistance

Given the documented risk of severe blunt trauma, ERIW deployment is difficult to justify against verbal resistance, passive resistance, minor noncompliance, or a person who poses little or no immediate safety threat.

Vulnerable anatomical target

Intentionally firing at the head, neck, chest, or another high-risk anatomical region can substantially increase the probability of serious injury or death. Where such targeting is intentional, the use may need to be assessed as potentially deadly force, regardless of the manufacturer's "less-lethal" designation.

Immediate lethal assault without tactical margin

An ERIW should not be treated as a firearm-equivalent stopping system. The Kobayashi and Mellen case (Kobayashi & Mellen, 2009) directly demonstrates that a 40 mm foam-nosed projectile can cause significant injury without incapacitating the person. In an edged-weapon confrontation, this matters greatly: if a subject is actively charging an officer or third party and can inflict lethal injury within seconds, the consequences of failed ERIW deployment may be catastrophic. Relevant considerations include distance, subject speed,

reaction time, cover, availability of lethal-force backup, target exposure, and whether failure can be safely tolerated.

Unsafe firing distance

Using a projectile inside the intended minimum range can increase injury severity, while using it beyond the effective range may reduce accuracy and effectiveness. Both conditions undermine the weapon's harm-reduction purpose.

Uncontrolled crowd firing

The broad kinetic-projectile literature documents severe injuries when projectiles are fired into crowds without reliable individual target identification. The more difficult it becomes to control target identity, anatomical target, firing distance, and background risk, the weaker the safety rationale for direct-fire kinetic projectiles.

Repeated impacts after control

Each projectile is a separate application of force. An initial justified round does not automatically justify later rounds after the person drops the weapon, the threat ends, the person becomes incapacitated, or officers otherwise obtain control.

Relevance to Edged-Weapon Encounters

Extended-range impact weapons offer an important edged-weapon capability because they allow officers to apply substantial physical force while remaining farther from the weapon than would be possible with a baton, handheld spray, or hands-on control. Their central limitation is that a successful hit is not synonymous with incapacitation.

Potential role

An ERIW may be used to interrupt threatening movement, cause localized motor dysfunction, create an opportunity for disarming or restraint, influence an armed but contained subject from behind cover, or attempt lower-lethality force before conventional firearm use. Its strongest potential role is therefore in dangerous but tactically controlled encounters.

Conditions favouring deployment

Deployment is more plausible where officers can maintain distance and cover, the subject is not already within immediate striking range, an appropriate lower-risk anatomical target is visible, the launcher is being used within its intended operating range, officers can tolerate a failed or incomplete effect, and lethal-force cover or another transition option is available where appropriate.

Failure consequences

The literature directly demonstrates that a 40 mm foam-nosed projectile can cause significant injury without incapacitating the subject (Kobayashi & Mellen, 2009). A hit may therefore hurt without stopping, strike an unintended area, fail to interrupt weapon use, or require additional rounds or escalation. Against an advancing edged-weapon subject, the time consumed by an unsuccessful impact may materially reduce the officer's ability to respond before contact.

Risk trade-off

For the subject, ERIW deployment may avoid firearm wounds but carries meaningful blunt-trauma risk, including severe injury if a projectile strikes vulnerable anatomy. For police and third parties, the principal risk is failed stopping effect. ERIW is best understood as a potentially valuable option where the encounter is contained enough that failure can be managed, and it should not be assumed to provide firearm-equivalent stopping reliability simply because it can be delivered from greater distance.

U.S. Legal Considerations

Fourth Amendment framework

ERIW use during a seizure is generally analyzed under the objective-reasonableness standard of *Graham v. Connor*. Relevant factors include the severity of the suspected offense, whether the person poses an immediate threat, whether the person is actively resisting or attempting to flee, the magnitude of the force used, anatomical target, whether a warning was feasible, whether officers had time for less intrusive alternatives, and whether the subject's conduct changed between successive uses of force. A "less-lethal" label does not determine the constitutional level of force; courts consider the actual force and foreseeable injury.

Sanderlin v. Dwyer

Sanderlin v. Dwyer, 116 F.4th 905 (9th Cir. 2024) is directly relevant to modern ERIW use. During a 2020 protest, Derrick Sanderlin was struck in the groin by a 40 mm foam baton round fired by a San Jose police officer. The Ninth Circuit affirmed denial of qualified immunity at summary judgment, holding – on the view of the disputed facts most favourable to Sanderlin – that a reasonable jury could find that he was peacefully protesting, did not present an immediate threat, that the projectile constituted a Fourth Amendment seizure, and that firing the 40 mm round was excessive. The court also concluded that the relevant right was clearly established for purposes of the qualified-immunity analysis. The case is important because it confirms that modern 40 mm foam rounds are constitutionally significant force, despite their less-lethal design.

Foundational projectile-force principles

Although *Deorle v. Rutherford*, 272 F.3d 1272 (9th Cir. 2001) (*Deorle v. Rutherford*, 2001) involved a beanbag-type impact projectile rather than a modern 40 mm sponge round, its principles remain relevant to ERIW analysis. The Ninth Circuit emphasized that less-lethal projectiles can cause serious injury, that force capable of causing

serious injury requires substantial governmental justification, that warning matters where feasible, and that an officer's desire to resolve a situation quickly does not itself justify severe force against a person who does not pose a commensurate threat.

Armed or emotionally disturbed subjects

Glenn v. Washington County, 673 F.3d 864 (9th Cir. 2011) (*Glenn v. Washington Cnty.*, 2011) involved beanbag deployment against a suicidal teenager holding a knife to his own neck. The case is relevant to ERIW policy because it emphasizes that weapon possession alone is not the end of the excessive-force analysis. The constitutional question remains focused on whether the person presents an immediate threat to officers or others, what the person is actually doing with the weapon, what alternatives are reasonably available, and whether police tactics escalated or reduced the danger. For an edged-weapon research project, that distinction is particularly important.

Qualified immunity

Qualified-immunity analysis remains highly fact-specific and circuit-specific. The law is increasingly clear, however, that officers cannot rely on the label "less lethal" to justify kinetic projectile use against a non-threatening person. The strongest clearly established principles include that substantial projectile force requires a meaningful governmental interest, that firing at a non-threatening person can violate clearly established law, that vulnerable-area impacts increase the severity of the intrusion, that warning is important where feasible, and that force must stop when the justification for it ends. Conversely, ERIW use is more likely to be found reasonable where the subject presents a serious, immediate threat and officers use a targeted impact in an effort to avoid firearm use.

Ethical and Moral Considerations

The ethical rationale for ERIW is primarily harm substitution. The weapon exists to create a force option between lower-level tactics that may be ineffective and conventional firearms that carry a high probability of death or catastrophic injury. That is a legitimate moral purpose, but the scientific evidence shows that reduced lethality is not the same as low harm.

Comparative harm

The strongest ethical justification is where the realistic alternative is firearm use. If a 40 mm impact round creates a reasonable chance of resolving a dangerous encounter without shooting the person with conventional ammunition, the potential reduction in expected harm can be substantial. The justification is weaker where the realistic alternative is time, distance, cover, communication, containment, negotiation, or another lower-injury force option.

Injury as part of the mechanism

ERIWs work by intentionally delivering enough mechanical energy to hurt or physically disrupt a person. Injury is therefore not merely an accidental side effect; the ethical question is whether the expected trauma is proportionate, necessary, targeted, and likely to prevent a greater harm.

Anatomical targeting

The strong association between head and neck impact and death or permanent disability creates a direct moral duty to control target selection wherever feasible. A policy that calls a projectile "less lethal" while tolerating avoidable head or neck impacts would be inconsistent with the evidence supporting the technology's harm-reduction purpose.

Historical misuse

Historical plastic-bullet literature shows that risk increases markedly when firing-distance and target-zone restrictions are ignored. Training, supervision, policy, and accountability are therefore not secondary administrative concerns – they are part of the weapon's ethical safety architecture.

Failure and tactical risk transfer

Attempting a lower-lethality option may appear morally preferable because it reduces intended harm to the subject. But if failure predictably exposes officers, victims, or bystanders to an immediate lethal assault, the attempt may simply transfer risk from one person to another. The ethical analysis must therefore consider total expected harm, not only harm to the person targeted.

Evidence Limitations

The ERIW evidence base has substantial limitations across several dimensions. First, modern platform-specific effectiveness data are sparse, with few independent studies reporting first-round success or encounter-resolution rates for contemporary 37/40 mm sponge systems. Second, the kinetic-projectile literature combines very different technologies, and rubber bullets, plastic baton rounds, beanbags, foam rounds, and sponge rounds should not be assumed to have identical risk profiles. Third, denominator data are weak, because most clinical studies begin with injured patients rather than all deployments. Fourth, crowd-control evidence may not generalize to patrol or tactical deployments. Fifth, older plastic-bullet data may overstate the risk of modern deformable sponge rounds while still accurately identifying general risk factors such as head impact and short firing distance. Sixth, serious injury is easier to publish than uneventful success, so the academic literature is vulnerable to publication and referral bias. Seventh, target location is frequently incompletely documented. Eighth, firing distance is often estimated or absent. Ninth, comparative effectiveness against CEWs, OC, and less-lethal shotguns remains poorly studied. Tenth, evidence specific to edged-weapon encounters is extremely limited.

The safest interpretation is therefore strong confidence that serious injury and death are possible, strong confidence that head, neck, and above-diaphragm impacts are substantially more dangerous, moderate confidence that distance and projectile design materially affect risk, and low-to-moderate confidence about how often modern ERIW deployment successfully resolves an encounter.

Bottom Line

Effectiveness

Low-to-moderate direct evidence. ERIWs can interrupt dangerous behaviour and offer officers a force option at greater distance, but independent peer-reviewed literature does not provide a reliable universal first-round incapacitation or encounter-resolution rate.

Injury

Meaningful blunt-trauma risk. Pulmonary contusion, liver injury, fractures, ocular injury, head trauma, and other serious injuries are documented.

Serious injury/death

Clearly possible. The broader kinetic-projectile literature documents permanent disability and death, especially after head and neck impacts and use outside intended firing conditions.

Comparative safety

Modern sponge and foam systems are designed to reduce risk compared with conventional firearms and older solid kinetic rounds, but the degree of risk reduction is not well quantified in independent deployment-level studies.

Tactical limitation

A hit is not synonymous with incapacitation. Modern-style 40 mm foam projectiles have caused significant injury without stopping the subject.

Risk-benefit assessment

The strongest justification for an ERIW is a dangerous but tactically controlled encounter where officers can maintain distance and cover, target a lower-risk anatomical area, tolerate possible failure, and potentially avoid conventional firearm use. Its weakest justification is against low-level resistance, in uncontrolled crowds, at unsafe range, toward vulnerable anatomy, or in an immediate lethal assault where failure would leave no tactical margin.

Core Peer-Reviewed Evidence

1. Haar, R. J., Iacopino, V., Ranadive, N., Dandu, M., & Weiser, S. D. (2017)

Death, injury and disability from kinetic impact projectiles in crowd-control settings: a systematic review.
BMJ Open, 7(12), e018154.
DOI: 10.1136/bmjopen-2017-018154

Priority: Essential / strongest broad safety synthesis.

Contribution: Reviewed 26 studies involving 1,984 people injured by kinetic impact projectiles.

Key finding: 53 deaths and 300 permanent disabilities were documented.

Anatomical finding: Head and neck impacts accounted for 49.1% of deaths and 82.6% of permanent disabilities.

Risk factors: Anatomical site, firing distance, and access to timely medical care were associated with injury severity.

Limitation: Combines multiple projectile designs and largely injury-selected populations; it cannot provide a modern 40 mm deployment-level injury probability.

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2. Kobayashi, M., & Mellen, P. F. (2009)

Rubber Bullet Injury: Case Report With Autopsy Observation and Literature Review.
American Journal of Forensic Medicine & Pathology, 30(3), 262–267.
DOI: 10.1097/PAF.0b013e318187dfa8

Priority: Essential modern projectile-mechanism paper.

Contribution: Describes injury from a 30 g projectile with a 40 mm sponge-foam nose and plastic body.

Key finding: The projectile caused pulmonary contusion but did not incapacitate the subject.

Key value: Directly demonstrates that clinically meaningful injury and operational failure can occur simultaneously.

Limitation: Single case; cannot estimate effectiveness or injury incidence.

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3. Suyama, J., Panagos, P. D., Sztajnkrycer, M. D., FitzGerald, D. J., & Barnes, D. (2003)

Injury patterns related to use of less-lethal weapons during a period of civil unrest.
The Journal of Emergency Medicine, 25(2), 219–227.
DOI: 10.1016/S0736-4679(03)00179-3

Priority: High real-world clinical evidence.

Contribution: Examined injuries from beanbag and other kinetic systems, including large foam projectiles launched from 40 mm rifles.

Key finding: Significant morbidity occurred in 7 of 25 included patients (28%), with injuries including pulmonary contusion, liver laceration, Achilles tendon rupture, pneumonia, and post-concussive syndrome.

Key value: Demonstrates serious injury patterns in actual deployment conditions.

Limitation: Treatment-based sample and mixed projectile types prevent calculation of deployment-level risk.

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4. Ritchie, A. J. (1992)
Plastic bullets: significant risk of serious injury above the diaphragm.
Injury, 23(4), 265–266.
DOI: 10.1016/S0020-1383(05)80013-0

Priority: High foundational anatomical-risk evidence.

Contribution: Reviewed 123 patients with 126 plastic-bullet injuries over 14 years.

Key finding: One death and several serious injuries occurred, with serious injury or death significantly associated with impacts above the diaphragm.

Key value: Strong support for anatomical target-zone restrictions.

Limitation: Historical plastic-baton-round data are not mechanically identical to modern sponge rounds.

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5. Metress, E. K., & Metress, S. P. (1987)
The Anatomy of Plastic Bullet Damage and Crowd Control.
International Journal of Health Services, 17(2), 333–342.
DOI: 10.2190/08GN-WR79-X908-8YE0

Priority: Foundational mortality and policy evidence.

Contribution: Reviewed fatal and severe injuries associated with plastic-bullet deployment in Northern Ireland.

Key finding: Thirteen deaths were documented, including seven children.

Policy finding: Many fatal deployments occurred at shorter-than-prescribed ranges or contrary to applicable rules of engagement.

Key value: Demonstrates that training and operating restrictions materially affect injury risk.

Limitation: Historical projectile technology and crowd-control context limit direct generalization to modern 40 mm sponge rounds.

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6. Manhas, N. S., Stahl, D., Schellenberg, M., & Gholamrezanezhad, A. (2021)
Non-lethal weapon: Injury patterns and imaging correlates for firearm alternatives.
Clinical Imaging, 79, 165–172.
DOI: 10.1016/j.clinimag.2021.03.007

Priority: High supporting medical synthesis.

Contribution: Reviews injury patterns and imaging findings associated with firearm alternatives, including kinetic impact projectiles.

Key value: Provides modern clinical context for blunt and penetrating injuries caused by less-lethal projectile systems.

Limitation: Covers multiple technologies rather than ERIW alone.

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7. Petersen, K., Koper, C. S., Taylor, B. G., Liu, W., & Sheridan-Johnson, J. (2025)
Less-Lethal Weapons and Civilian Injury in Police Use of Force Encounters: A Multi-agency Analysis.
Journal of Urban Health, 102(2), 389–399.
DOI: 10.1007/s11524-024-00940-1

Priority: Important modern comparative field study.

Contribution: Analyzed 2,348 use-of-force incidents from 17 large urban and metropolitan agencies.

Key finding: Adjusted predicted hospitalization or death was approximately 16% for the broad impact-weapon category, compared with 4% for chemical agents, 13% for CEWs, and 37% for police canines.

Key value: Provides contemporary comparative injury context.

Limitation: The impact category is broader than modern ERIW systems and cannot isolate 37/40 mm projectiles.

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8. Bozeman, W. P., Stopyra, J. P., Klinger, D. A., Martin, B. P., Graham, D. D., Johnson, J. C., Mahoney-Tesoriero, K., & Vail, S. J. (2018)

Injuries associated with police use of force.

Journal of Trauma and Acute Care Surgery, 84(3), 466–472.

DOI: 10.1097/TA.0000000000001783

Priority: Supporting real-world comparative evidence.

Contribution: Prospective multicentre study of 893 police use-of-force incidents with physician assessment of injury severity.

Key value: Includes kinetic impact munitions within a medically reviewed real-world police cohort.

Critical limitation: Only eight kinetic impact munition uses occurred, making ERIW-specific statistical inference impossible.

Evidence Rating

Operational effectiveness: ★★☆☆☆ to ★★★☆☆

Independent first-round and encounter-resolution data are limited.

General injury evidence: ★★★★☆

Substantial clinical and forensic literature documents predictable injury mechanisms.

Serious-injury probability: ★★★☆☆

Serious injury is clearly possible, but deployment-level probability cannot be reliably estimated.

Mortality evidence: ★★★☆☆

Death is well documented across the broader kinetic-projectile literature, especially with older systems and vulnerable-area impacts, but modern platform-specific mortality rates are unknown.

Comparative evidence: ★★★☆☆

Some contemporary comparative data exist, but ERIW is usually aggregated within broader impact categories.

Anatomical/range evidence: ★★★★★

The evidence that target location and firing distance materially affect injury severity is strong and consistent.

Modern platform-specific evidence: ★★☆☆☆

Contemporary 40 mm sponge/foam systems remain under-studied independently.

Overall confidence: Moderate for injury mechanisms; low-to-moderate for operational effectiveness and platform-specific risk.

Research-library conclusion

Extended-range impact weapons provide police with a distinct tactical capability: the ability to deliver targeted blunt force from substantially greater distance than a baton, handheld chemical spray, or hands-on intervention while attempting to avoid conventional firearm lethality. The evidence strongly supports the proposition that anatomical target, firing distance, and projectile design determine much of the resulting injury risk. Head and neck impacts are disproportionately associated with death and permanent disability in the broader kinetic-projectile literature, and even modern foam-nosed 40 mm rounds can cause clinically significant thoracic injury without incapacitating the subject. At the same time, independent peer-reviewed evidence on first-round success, encounter resolution, and modern 40 mm deployment-level injury probability remains surprisingly weak. ERIWs should therefore be understood as reduced-lethality kinetic weapons rather than inherently safe projectiles. Their strongest justification is in dangerous but tactically controlled encounters where officers have distance, cover, an appropriate target zone, and the ability to manage failure while potentially avoiding firearm use. Their weakest justification is against low-level resistance, in uncontrolled crowds, at unsafe range, toward vulnerable anatomy, or in immediate lethal assaults where unsuccessful incapacitation would leave no margin for recovery.

References

Bozeman, W. P., Stopyra, J. P., Klinger, D. A., Martin, B. P., Graham, D. D., Johnson, J. C., . . . Vail, S. J. (2018). Injuries associated with police use of force. *Journal of Trauma and Acute Care Surgery*, *84*(3), 466–472. https://doi.org/10.1097/TA.0000000000001783

Deorle v. Rutherford (2001). 272 F.3d 1272, 9th Cir.

Glenn v. Washington Cnty., 673 F.3d 864 (9th Cir. 2011) (2011). 673 F.3d 864, United States Court of Appeals, Ninth Circuit. https://casetext.com/case/glenn-v-washington-cnty

Haar, R. J, Iacopino, V., Ranadive, N., Dandu, M., & Weiser, S. D. (2017). Death, injury and disability from kinetic impact projectiles in crowd-control settings: a systematic review. *BMJ Open*, *7*(12), e018154. https://doi.org/10.1136/bmjopen-2017-018154

Kobayashi, M., & Mellen, P. F. (2009). Rubber Bullet Injury: Case Report With Autopsy Observation and Literature Review. *American Journal of Forensic Medicine & Pathology*, *30*(3), 262–267. https://doi.org/10.1097/PAF.0b013e318187dfa8

Metress, E. K., & Metress, S. P. (1987). The Anatomy of Plastic Bullet Damage and Crowd Control. *International Journal of Health Services*, *17*(2), 333–342. https://doi.org/10.2190/08GN-WR79-X908-8YE0

Petersen, K., Koper, C. S., Taylor, B. G., Liu, W., & Sheridan-Johnson, J. (2025). Less-Lethal Weapons and Civilian Injury in Police Use of Force Encounters: a Multi-agency Analysis. *Journal of Urban Health*, *102*(2), 389–399. https://doi.org/10.1007/s11524-024-00940-1

Ritchie, A.J. (1992). Plastic bullets: significant risk of serious injury above the diaphragm. *Injury*, *23*(4), 265–266. https://doi.org/10.1016/S0020-1383(05)80013-0

Suyama, J., Panagos, P. D, Sztajnkrycer, M. D, FitzGerald, D. J, & Barnes, D. (2003). Injury patterns related to use of less-lethal weapons during a period of civil unrest. *The Journal of Emergency Medicine*, *25*(2), 219–227. https://doi.org/10.1016/S0736-4679(03)00179-3

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