IMPACT MUNITIONS

DATA BASE

OF USE AND EFFECTS

A Grant funded by the

NATIONAL INSTITUTE OF JUSTICE

Under the Solicitation for Law Enforcement, Courts and Corrections Technology Development, Implementation and Evaluation

Category 4

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Supported under Award number 98-LB-VX-K006 from the Office of Justice Programs, National Institute of Justice, Department of Justice. Points of view in this document are those of the authors and do not necessarily represent the official position of the U.S. Department of Justice.

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Project Abstract

Controversies surrounding police handling of race riots, student demonstrations, and other civil disturbances in the 1960s and '70s made it painfully obvious that American law enforcement needed to develop new tactics, techniques, and technologies to properly handle such events. One result of this realization was the introduction of firearm-delivered impact munitions such as rubber bullets, wooden dowels, and bean bags that officers could employ during disturbances when lethal munitions were not appropriate. As the use of deadly force by police came under increasing public scrutiny in the 1980s, some police agencies began to use impact munitions as a means to resolve other volatile situations. This trend continued through the 1990s and into the current century as police increasingly used impact munitions to apprehend fleeing felons, suppress prison riots, arrest violent suspects, subdue armed suicidal subjects, and accomplish various and sundry other law enforcement tasks. While impact munitions usage has increased dramatically in the recent past, we have very little systematic information about the circumstances under which they are employed and even less about the effects they have on the citizens against whom they are used. This knowledge gap presents a problem for law enforcement officers and policy makers as they consider how best to resolve volatile police-citizen confrontations. The study described in this report was undertaken to gather data about the use and effects of impact munitions in order to inform both the policy makers who must choose whether and how to integrate impact munitions into their agencies' use of force options and the line officers who might employ them in the field.

Information was collected via a survey of North American law enforcement agencies that include impact munitions in their weapons inventory. The agencies were asked to report on each case where members of their agency fired impact munitions at citizens since the time that their department began using them. The data collection process yielded reports on 373 separate incidents where officers fired at least one impact projectile at citizens. This report focuses on what the analysis of these 373 cases discloses about using impact munitions against citizens and discusses the implications of these findings for contemporary law enforcement.

BACKGROUND

At the core of the police mission to preserve life and protect property lies their capacity to use coercive force against citizens whose actions threaten the peace, endanger innocent lives, or otherwise interfere with officers' lawful execution of their duties (e.g., Bittner, 1990). Because the criminal law is imprecise about how much force officers may use in any given confrontation, police departments have developed "use of force" continua to guide officers' actions during interactions with citizens. At the top of the generic continuum lies deadly force, which officers may employ only to protect themselves or others from imminent threats to life and limb and to effect the arrest of violent felons. Immediately below deadly force lie an assortment of tactics and tools such as handheld impact weapons, (police batons, expandable batons, nunchakus), TASERS and other electronic stun devices, and chemical agents -- such as OC and CS -- that officers may use to subdue combative subjects and protect themselves and others from attacks that are not likely to produce serious injury or death. One problem the police face is that the effective use of most of these force options requires that officers be in close proximity to their opponent, which increases the risk to officers and thus presents the possibility that an altercation may escalate to a point where deadly force becomes necessary. Impact munitions were developed and subsequently deployed in hopes of bridging this problematic gap in the force continuum.

The term "impact munitions" refers to a group of firearm-delivered projectiles that have a low probability of causing serious bodily injury or death when they strike human targets. American law enforcement first seriously considered the need for such weapons during the late 1960s and early '70s as it became increasingly evident that extant police tools, tactics, and technologies were not well-suited for handling the race riots, student uprisings, and other civil disturbances that marked that era. During this time, some police agencies added impact munitions to their weapon inventories in order to increase the force options available to them for dealing with mass disturbances. These impact munitions, such as wooden dowels, foam rubber projectiles, and small bean bags, could be fired from 12 gauge shotguns and 37 millimeter gas launchers. The next major step in the diffusion of impact munitions in American law enforcement came in response to a different sort of problem, one that emerged in the late 1970s and early 80s as the nation moved away from institutionalizing mentally and emotionally disturbed individuals.

As the de-institutionalization movement proceeded apace, officers were increasingly called upon to deal with mentally and emotionally disturbed citizens (hereafter called EDPs) – some of who were clearly suicidal – that had armed themselves with dangerous weapons such as baseball bats, clubs, knives, swords, and other edged weapons. Many such interactions ended in police gunfire, as officers could not safely disarm the citizen in question with available force options short of deadly force (e.g., kicks, baton strikes, and aerosol-delivered irritants such as CS). As community condemnation of such shootings grew, police administrators and line officers alike began to look for fresh approaches to dealing with armed EDPs. One result of this effort was that many agencies began deploying firearms loaded with impact munitions to confrontations with armed EDPs. With impact munitions at their disposal, officers could keep a safe distance between themselves and armed EPDs while applying force that was not likely to cause death or serious injury, and thus substantially reduce the odds that they would have to resort to deadly force.

Initially, impact munitions were deployed by officers assigned to Special Weapons and Tactics (SWAT) teams who were called when patrol officers requested assistance in dealing with an armed EDP. In recent years, however, more and more agencies have equipped patrol personnel with impact munitions in order to increase their capacity to deal with armed EDPs, as well as other situations where they might need to use non-deadly physical force from a distance. The deployment of impact munitions by SWAT teams has also expanded to include many other circumstances besides dealing with EDPs. Today, for example, many SWAT teams have impact munitions readily available when dealing with barricaded suspects and serving high risk warrants so that they can quickly subdue combative suspects who do not present a deadly threat. Indeed, as the usage of impact munitions has increased over the years, more and more agencies have added weapons specifically designed to launch specific impact projectiles. Among the more popular of these specialty weapons are the ARWEN (Anti-Riot Weapon-Enfield)-37 and Sage SL-6, two launchers with five and six-round drum magazines respectively, that permit the operator to fire multiple munitions before stopping to reload. These two weapons are depicted in Photo #1 below.

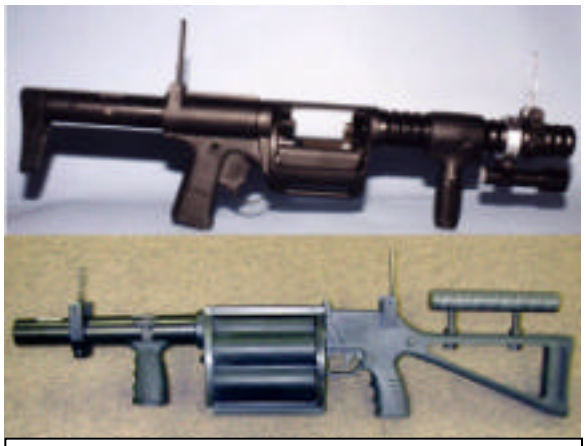


Photo #1: 37mm Plastic Baton Launchers
ARWEN-37 above and Sage SL-6, below

While more and more police agencies are deploying impact munitions in a wider variety of situations via a broader array of launching systems, there exists very little systematic information about the circumstances under which they are actually fired and even less about the effects they have when they strike citizens. The research project described below was undertaken to shed some empirical light on these important issues.

PROJECT METHODOLOGY

We determined that the most logical way to collect information about impact munitions usage and effects was to obtain case reports describing salient features of police confrontations with combative and potentially violent citizens where officers fired such munitions. Because we wished to collect information about the largest possible number of cases, we set out to survey all North American police agencies that count impact munitions among their force options. Because different agencies utilize different records-keeping systems, we developed a case-based data collection instrument that officers could complete and send in following incidents where members of their agency fired impact

munitions. This one page instrument, a copy of which can be found in Appendix 1, sought the following information:

- Agency name
- Date of incident
- Time incident started
- Time incident ended
- Incident type (see discussion below for details)
- Subject's age
- Subjects' sex
- Subject's height
- Subject's weight
- Subject's race
- Subject's build (see discussion below for details)
- Type of weapon(s) the suspect possessed (see discussion below for details)
- Type of clothing the subject wore
- Number of impact munitions fired during incident
- Number of munitions that struck subject
- Type of impact munitions fired (see discussion below for details)
- Distance between officer and subject when officer fired the munitions
- Area on suspect's body munitions impacted (see discussion below for details)
- Type of injury subject sustained from munitions
- Whether the subject received a medical examination
- Whether the subject was admitted into a hospital for medical or psychiatric reasons

After designing the instrument, we set out to develop a sample of North American law enforcement agencies that include impact projectiles in their ammunition inventories. As the first step in this process, we contacted the five largest impact munitions manufacturers (all impact munitions used by North American law enforcement agencies are produced by private firms) and asked for their client lists. Four of these companies complied with our request. In the end, the information supplied by the manufactures yielded a list of 685 different police and corrections agencies that had purchased impact munitions from at least one company. We then sent each of these agencies a packet that included copies of the data collection instrument and a letter of introduction that described the study and requested their participation in it. We also sent a follow-up mailing reminding each of these agencies about the project approximately three months later. Additionally, we took steps to develop information from agencies that did not appear on the manufacturers' client lists, but that might nonetheless be using impact munitions. We submitted to several law enforcement journals and newsletters an article that described the study and sought participation from interested agencies. We also posted information about the project and how interested agencies could participate on the web site of the California Association of Tactical Officers (CATO). In the end, these efforts yielded a total of 373 separate case reports from 106 different law enforcement agencies. Nine (9) of these cases were submitted by state agencies, 80 by county agencies, and 284 by municipal agencies (no corrections agencies sent in any reports).

Many of the reports submitted did not include information on each point of information we requested. Follow-up phone calls were made to those agencies that submitted incomplete reports in an attempt to obtain the missing data. Unfortunately, these calls did not always result in additional information. Consequently, the data set includes substantial missing data for some variables.

Before moving on to a discussion of what the data we collected disclosed about the use and effects of impact munitions, a few words of caution about one a specific issue are in order. In order to provide what we believe is appropriate detail, this report mentions several specific impact munitions and projectile delivery systems by name. Nothing herein should be taken as either an endorsement or a criticism of any specific projectile, delivery system, or manufacture of these devices. The information on specific products is offered **solely** for the sake of clarity.

Two Units of Analysis

Analysis of the data moved along two separate paths. The first was an incident-based analysis that treated each of the 373 incidents where officers fired impact munitions as a separate case. The second was a munitions-based analysis that treated each of the 969 projectiles fired during these 373 incidents as a separate case. This analytical strategy allowed us to explore not only what occurs in incidents where officers employ impact munitions, but to also examine the effects of each projectile fired. Presentation of what these analyses disclosed begins with a discussion of background information regarding the 373 incidents where officers fired impact munitions.

FINDINGS

Background Information on Incidents

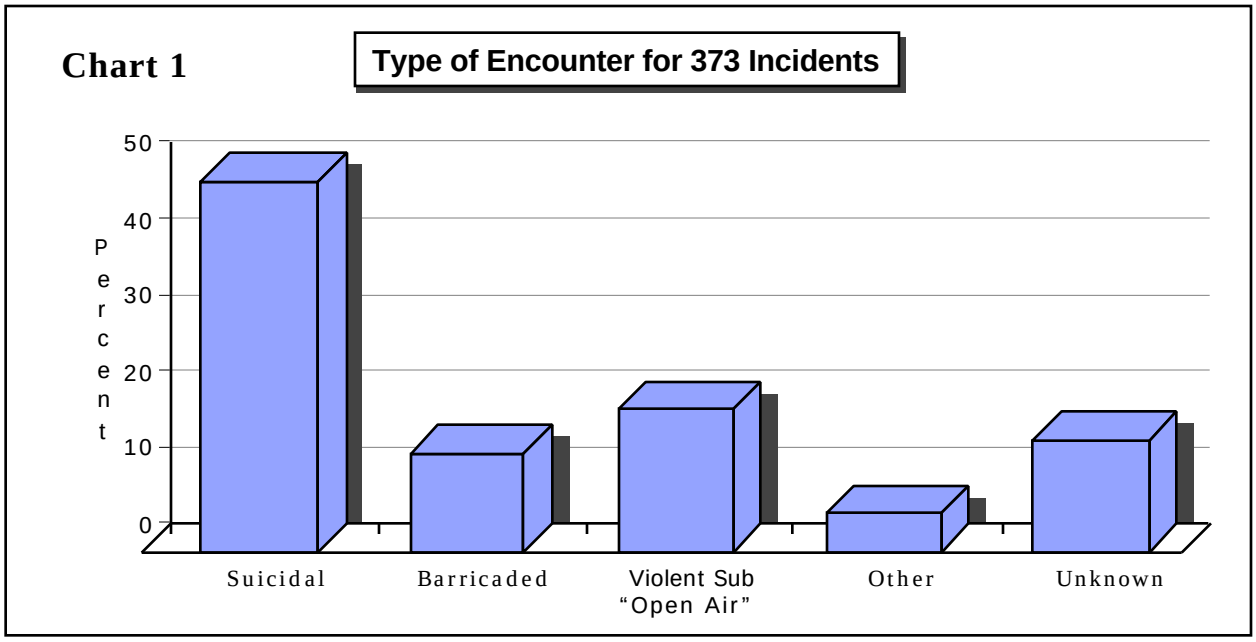
Each of the means we used to inform the law enforcement community about the project indicated that we wished to receive reports about any and all of the incidents where members of their agency fired impact munitions since the time they added these projectiles to their force inventory. The earliest incident reported occurred in 1985, four others occurred during the remaining years of the 1980s, 56 others occurred during the first five years of the 1990s, while the remaining 312 cases occurred between 1995 and early 2000.

In order to get some sense of the geographic location of the incidents where officers employed impact munitions, we grouped the 106 agencies that submitted reports into the following five regions: Northeast, Midwest, South, West, and Canada.[1] The lion's share of the cases reported – 70% – occurred in the Western region of the U.S., nine percent (9%) occurred in the South, five

[1] The regional classification we used is the same one the FBI uses in its Uniform Crime Reports. To wit: Northeast - Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Pennsylvania
Midwest - Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
South - Delaware, DC, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas
West - Arizona, Colorado Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, Washington

percent (5%) in the Midwest, four percent (4%) in the Northeast, while the remaining 12% occurred in Canada.

Another aspect of the context in which impact munitions are used is the type of problem confronting the involved officers. Impact munitions have received a great deal of attention from law enforcement as a possible means of de-escalating numerous types of violent encounters, and thus minimizing injuries to both citizens and officers (Ijames, 1995). As discussed above, one of the more problematic types of crises officers have been called upon to manage in recent years are those involving armed EDPs who exhibit signs of suicidal intent. Such events make up the largest category of incidents in the current data, accounting for nearly half (N=181). Seventy (70) other cases involved armed individuals in open places who refused to comply with officers' orders to surrender, but did not appear to be suicidal (identified as "open air" henceforth). In 48 other cases, officers fired impact projectiles at non-suicidal subjects who had barricaded themselves inside structures or vehicles.[2] Among the 19 remaining cases were nine (9) hostage incidents, two (2) civil disturbances,[3] and an assortment of various and sundry other sorts of situations. Fifty-five of the reports submitted did not indicate the type of encounter and follow-ups failed to provide this information. See Chart 1 for a graphic display of the percentage distribution of incident type.



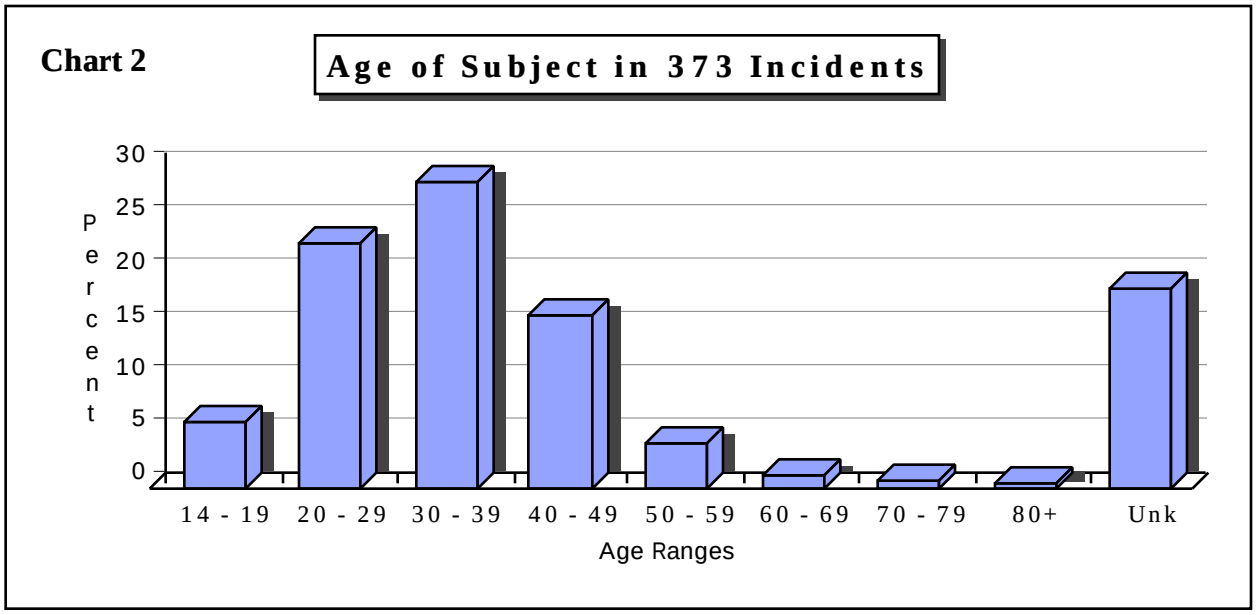
[2] Two definitional points should be noted here. The first is that in those cases classified as "suicidal" the subject could be either barricaded or in the open air. Thus, as implied in text above, the "barricade" and "open air" classifications apply to cases that involve subjects that do not exhibit signs of suicidal intent. The second point is that the data included some cases whose nature shifted from the time officers arrived to the time they employed less-lethal projectiles. Cases were classified according to the nature of the situation *at the time that officers fired impact munitions*. Thus, for example, a case that began as a hostage-taking incident, but changed to a barricade prior to officers' firing when the hostage taker released the hostage(s), would be classified as a barricade.

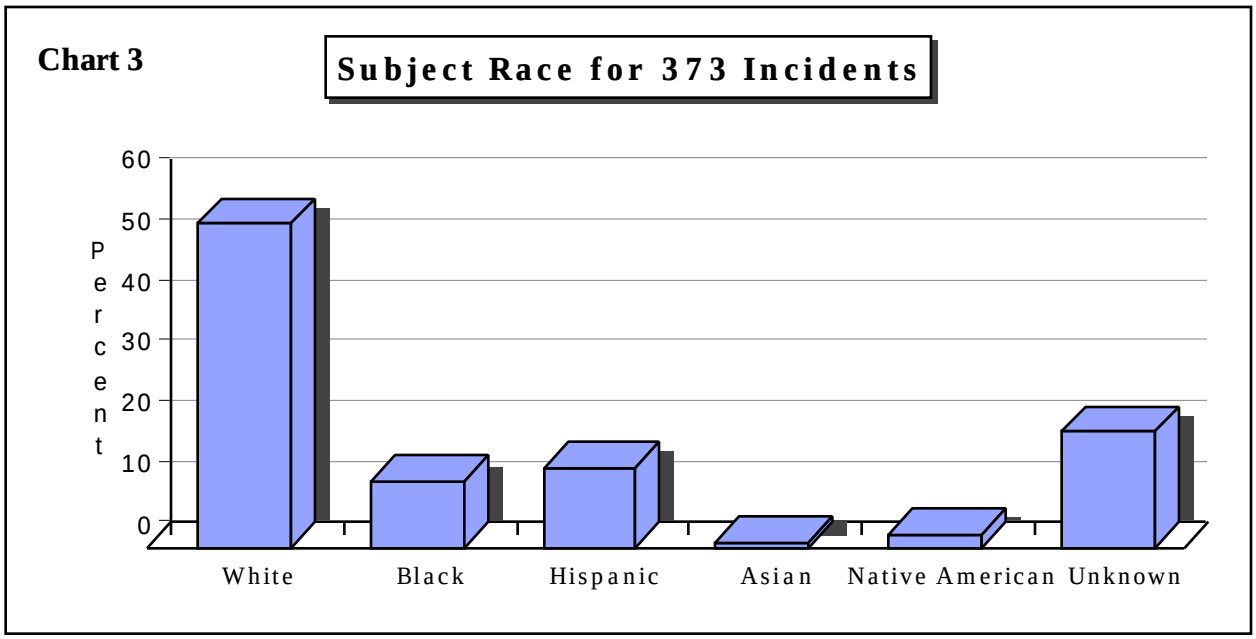
[3] Both of the civil disturbance cases came from Canada. We know through informal channels (e.g., news reports and discussions with involved officers) that officers from several US law enforcement agencies fired impact munitions during civil disturbances on US soil in the recent past. Unfortunately, none of these agencies were willing to participate in this study.

Subjects' Characteristics

Socio-demographic Profile

There was substantial diversity in the demographic characteristics of the subjects involved in the cases included in the current study. Among the 299 cases for which respondents provided information on subjects' age, the youngest were two 14 year-olds, while the eldest subject fired upon was 83. The mean age was just short of 34, the median was 33, while the modal age was 40 (N=16). To get some general sense of subjects' age, we grouped them by 10 year increments, with 14-19 as the low anchor point and 80+ as the high. As displayed in Chart 2 below, the largest number of cases involved subjects in their 30s (as one might have suspected given knowledge of the mean and median values), followed by 20 year-olds, and subjects in their 40s. Among the 315 cases where the sex of the subject was reported, the vast majority of them (291) involved male subjects. Finally, among the 301 cases where respondents included information on the subjects' race, 200 involved white subjects. Hispanics (N=49) were next, followed by blacks (N=40), Native Americans (N=8), and Asians (N=4). The Race/Ethnic distribution of the subjects is displayed in percentage form in Chart 3 below.

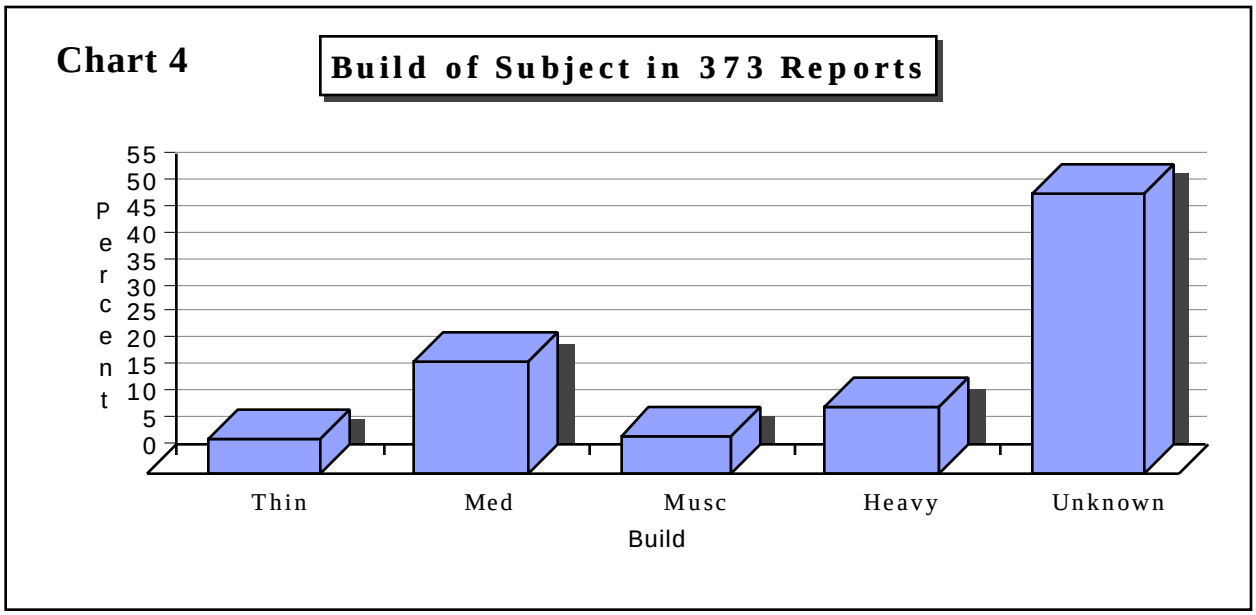




Subjects' Build

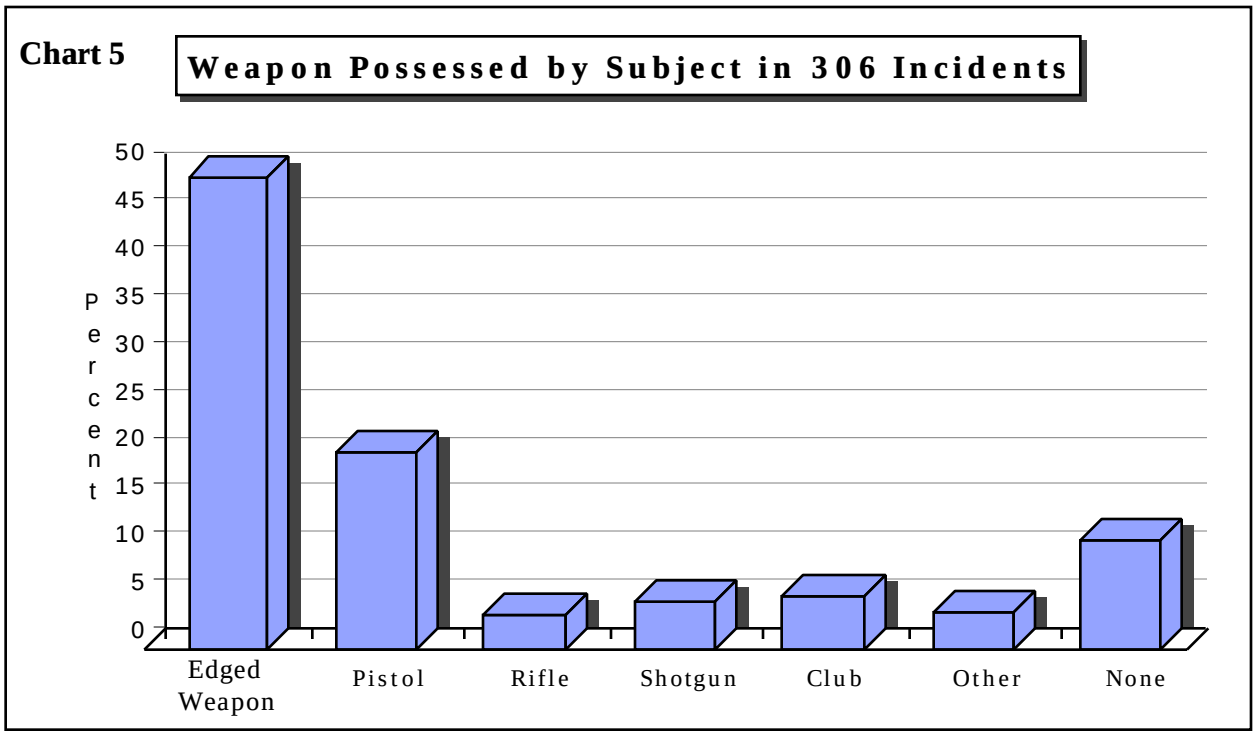
We wished to assess the role that the morphology of individuals struck by impact munitions plays in the efficacy of such projectiles for resolving the problems that led to their use and in the degree of injury sustained by subjects. We sought three separate points of information to develop a sense of subjects' builds. The first two were height and weight, the third was the subjective assessment of the person filling out the report about whether the subject's build was "thin," "medium," "muscular," or "heavy." Unfortunately, more than half of the reports submitted did not include an assessment of the subject's build and only a few of the follow-up phone calls produced the relevant information. We entertained the idea of attempting to re-construct the missing build information for those cases where height and weight were provided by combining these two pieces of information. We abandoned the idea when a review of the height, weight, and build information among the cases where all three points of data were present indicated that we could not meaningfully distinguish between builds based on height and weight parameters alone. In the end then, we were left with 176 cases where respondents reported the build of the subject involved: 24 thin, 78 medium, 27 muscular, and 47 heavy. This information is presented in Chart 4 below.[4]

[4] Information on other aspects of the subjects that officers confronted (e.g., the clothing they wore, degree of intoxication, etc.) was missing from so many of the 373 cases that consideration of these factors would not shed any meaningful light on the matter at hand.



Subjects' Weapons

Where the weapons possessed by subjects goes, we had substantially more success in getting the information we sought, netting this data in 306 of the 373 cases. A handful of these 306 cases involved subjects who possessed multiple weapons. For simplicity's sake, we counted only the most dangerous weapon these subjects possessed. Thus, for example, a subject who carried a shotgun in one hand and a knife in the other would be classified as being armed with a shotgun. As displayed in Chart 5 below, nearly 90% of the subjects possessed at least one weapon during the confrontation wherein they were shot with impact munitions. By far the most popular weapons carried were cutting implements, such as swords, machetes, knives, and axes. Subjects possessed edged weapons such as these in 50% of the cases for which weapons data was supplied. Subjects possessed some sort of firearm in 29% of the cases, with handguns carried most frequently (N=64), followed by shotguns (N=15) and rifles (N=11). Subjects were armed with blunt instruments such as clubs, bats, and sticks in six percent (6%) of the cases, and miscellaneous objects such as rocks, bottles, and Molotov cocktails in another four percent (4%). Finally, subjects carried no weapons in 11% (N=35) cases.



Projectiles Fired

There was a substantial range in the number of munitions officers fired and the number of projectiles that struck their targets: from 1 to 141 among the 316 cases for which data on the number of rounds discharged was provided. As indicated in Table 1 below, the low number in the range was the modal category, with officers firing a single round in 122 of the cases. The tendency for officers to use fewer rather than more munitions is further evidenced in the final column in Table 1, which shows that five or fewer rounds were expended in 93% of the cases and 10 or fewer in 98%.

Table 1: Number of Impact Munitions Fired in 316 Cases

Number Fired	*Frequency*	*Percent*	*Cumulative Percent*
1	122	38.6	38.6
2	70	22.2	60.8
3	47	14.9	75.6
4	35	11.1	86.7
5	20	6.3	93.0
6	9	2.8	95.9
7	1	.3	96.2
8	1	.3	96.5
9	3	.9	97.5
10	1	.3	97.8
11	2	.6	98.4
13	3	.9	99.4
32	1	.3	99.7
141	1	.3	100.0
Total	316	100.0	

Projectile Impacts

Respondents reported on the number of rounds that struck their intended target in 313 of the incidents. As indicated in Table 2, the number of hits per case ranged from none (in one case) to 13 (in one other). As was the case with the number of projectiles fired, the modal number of hits is one (N=135). And, as would be expected given the knowledge that 10 or fewer rounds were fired per incident, the vast majority -- 99.5% -- of the subjects were struck by 10 or fewer projectiles (and over 90% were struck by four or fewer).

Table 2: Number of Munitions Striking Subjects in 313 Cases

Number of Hits	*Frequency*	*Percent*	*Cumulative Percent*
0	1	.3	.3[5]
1	135	43.1	43.5
2	69	22.0	65.5
3	52	16.6	82.1
4	26	8.3	90.4
5	14	4.5	94.9
6	7	2.2	97.1
7	1	.3	97.4
8	0	---	---
9	4	1.3	98.7
10	2	.6	99.4
11	0	---	---
12	1	.3	99.7
13	1	.3	100.0
Total	313	100.0	

With the foregoing information about the nature of the 373 incidents in hand, attention now turns to the analysis of the 969 separate projectiles fired across these incidents. It begins with an overview of the sorts of projectiles that were used.

Munitions Used in the Current Study

Respondents identified the type of munitions used in 962 of the 969 discharges reported in the study. This information indicates that officers used 21 different specific types of munitions. 12-gauge bean bag rounds were by far the most commonly used munitions among the 962 rounds identified, accounting for 623 (65%) of the projectiles fired. 37mm plastic baton rounds (PBR's)

[5] The single case with no hits comes from an incident where the subject surrendered after each of two munitions fired at him missed their mark. Examination of the report narratives indicated that several subjects surrendered in similar fashion when follow-up rounds missed them after they had refused to give-up when the initial rounds fired struck them.

make up the second most prevalent class of impact munitions used (N = 267). The remaining 69 munitions that respondents identified included a variety of other 12-gauge, 37mm, and 40mm projectiles.

The three specific 12-gauge bean bag rounds most frequently used were (in descending order) the "Standard" MK Ballistic Systems Flexible Baton-12 (aka MK12S), the Defense Technology DT23BR, and the "Close Range" MK Ballistic Systems Flexible Baton –12 (aka MK12C). All three of these rounds consist of 2" square cloth pillows filled with 40 grams of lead shot. According to manufactures' specifications, the MK12S (i.e., the "Standard" projectile) has a muzzle velocity of 300 feet per second (fps), the DT23BR has a muzzle velocity of 300 fps, and the MK12C has a muzzle velocity of 230 fps (see Defense Technologies, 1999 and MK Ballistic, 1995). Among 37mm PBR's, the Sage Control Ordnance KO1 and the Royal Ordnance AR 1 appeared most frequently in the current data. Photo 2 below displays all three of the above-mentioned bean bag rounds. Photo 3 below displays the KO1 PBR and the cartridge in which it is encased prior to firing. Chart 6 below displays the percentage distributions of projectiles fired by specific munitions type, with those used in a handful of cases grouped together as "other" (N= 89).

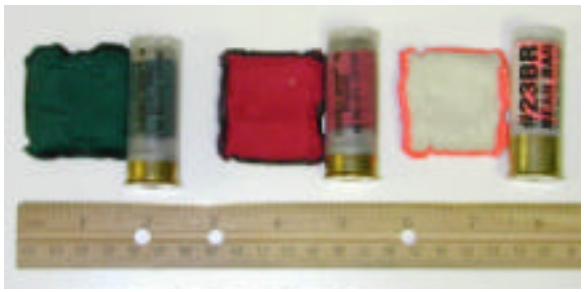
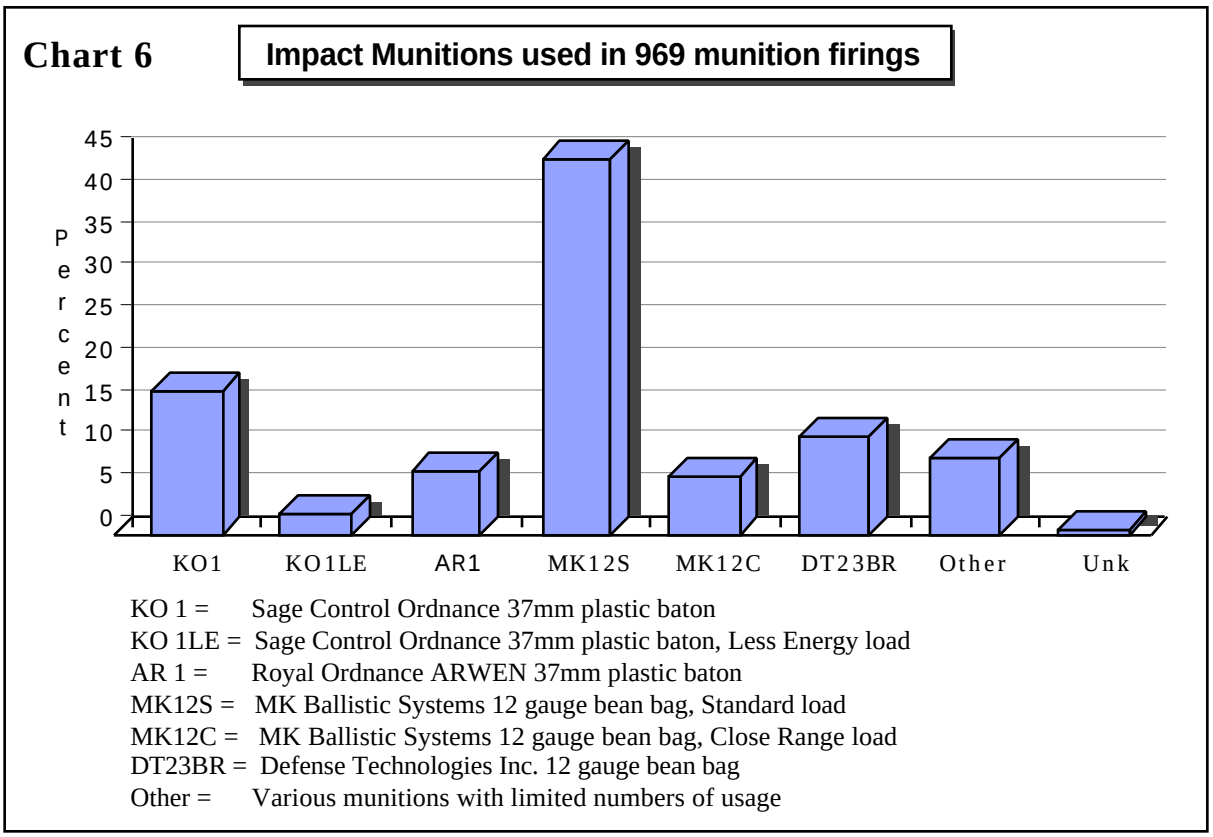


Photo #2
12 ga. Bean Bag Impact Munitions
MK Ballistic Systems-Close range (green)
MK Ballistic Systems-Standard (red)
Defense Technologies #23BR (white w/red stitching)

Photo #3
Sage Control Ordinance, Inc.
KO 1 Cartridge & Plastic Baton Round

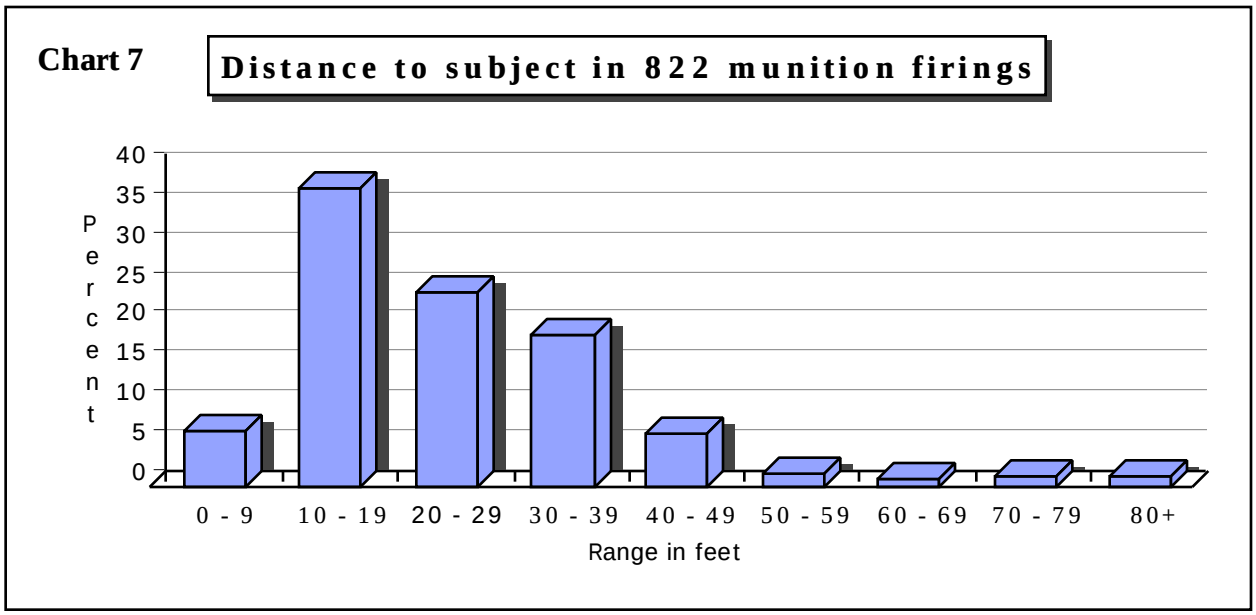


Distance Between Officers and Subjects

The data collection instrument included an item that asked respondents to report the approximate distance (in feet) at which each projectile was fired. Respondents reported distances for 822 of the 969 projectiles fired. In the vast majority of cases these distances were reported with a single number. Some reports, however, listed a range within which the actual distance would fall. In most of theses cases the range indicated was five feet (e.g., 20-25 ft), in several others it was 10 feet, while three projectiles were reportedly fired between 45 and 60 feet away from the subject. In all cases where a range rather than a single number was reported, we entered the average of the two numbers as the distance at which the projectile in question was fired. Thus, for example, we entered 53 feet for each of the three munitions that were reported as having been fired from between 45 and 60 feet.

The closest reported distance between officer and subject at time of firing was two (2) feet (in two cases), while the farthest was 96 feet (in four cases). For simplicity's sake, the remainder of the information about distances will be presented in 10 foot increments. As indicated in Chart 7, the largest number of projectiles (38%) were fired from 10 to 19 feet away from the subject. As distance increases, the proportion of cases in each distance increment decreases; 25% of the projectiles were fired from the 20-29 foot range, 19% between 30 and 39 feet, seven percent (7%) between 40 and 49 feet, and five percent (5%) from distances of 50 feet or more.[6]

[6] Fourteen rounds were fired in the 50-59 foot range, seven (7) in the 60s, 11 in the 70s, 0 in the 80s, and 11 in the 90s.



Body Area Struck by Projectiles

Respondents were asked to indicate where on the subject's body each projectile that hit its intended target landed. Those that did not strike the subject were reported as misses and hits were reported by placing marks on the figures in the lower right corner of the data collection instrument. These marks were then grouped into the following categories for data entry:

Head (includes face),
Neck (includes throat),
Chest,
Back,
Arm (includes shoulder and hand),
Abdomen,
Leg (includes hip),
Groin,
and Buttocks

Respondents provided information about whether and where 867 of the 969 projectiles fired struck subjects.[7] Seven-hundred ninety-seven of these 867 projectiles -- 92% -- impacted the subject at whom they were fired; the other 70 rounds missed. The single area of subjects' bodies struck most often was the abdomen, as 34% of all projectiles that were known to have struck subjects impacted this area. Four other areas accounted for at least 10% of the strikes, with the chest (19%) leading the way, followed by the legs (15%), arms (14%), and back (11%). The remainder of the rounds

[7] One problem that presented it self in this aspect of data collection concerns cases where officers fired multiple rounds at a given subject. If more than one type of munitions was used and the subject was struck in more than one place on his or her body in such cases, officers would have a hard time determining which projectile impacted where. This problem contributed to the scope of the missing data for this variable.

known to have hit struck subjects on their buttocks (4%), head (2%), groin (1%) and neck (1%).[8] The figures for the location of impact munitions strikes are presented in Table 3 below.

Table 3: Area of Body Struck by 797 Projectiles That Hit Subjects

Area Struck	*Frequency*	*Percent*	*Cumulative Percent*
Abdomen	263	33.1	33.1
Chest	152	19.1	52.3
Back	85	10.7	63.0
Groin	7	.9	63.9
Leg	119	15.0	78.8
Arm	115	14.5	93.3
Buttocks	28	3.5	96.9
Head	19	2.4	99.2
Neck	6	.8	100.0
Total	797	100.0	

Injuries Sustained by Subjects

Respondents reported on the injuries caused by 782 of the munitions that impacted subjects. As indicated by the figures presented in Table 4, bruises were by far the most common injury subjects sustained, occurring in 51% of the munitions strikes. Another 31% of the munitions caused abrasions, 6% lacerated subjects' skin, 4% led to fractured bones, 2% penetrated subjects' skin, 1% led to the death of the subject (see discussion below), while 6% of the munitions that struck subjects caused no physical injury.[9] Before pressing on, one important note must be stated. The number of deaths in Table 4 below include two fatalities that were caused by *lethal rounds* that officers mistankly fired during encounters where officers intended to less-lethal munitions. These two cases are excluded in subsequent tables.

Table 4: Injury Sustained by Subjects from 782 Projectile Impacts

Injury Sustained	*Frequency*	*Percent*	*Cumulative Percent*
Bruise	398	50.9	50.9
Abrasion	239	30.6	81.5
Laceration	43	5.5	87.0
Fracture	27	3.5	90.5
Penetration	14	1.8	92.3
Death	10	1.3	93.6
None	51	6.5	100.0
Total	782	100.0	

One of the crucial issues in impact munitions concerns the relationship between the distance at which projectiles are fired and the degree of injury that subjects sustain. As with traditional law

[8] Adds to 101% due to rounding error

[9] Respondents reported that five (5) of the projectiles that caused no injury did, however, produce "pain."

enforcement impact weapons, impact munitions rely on kinetic energy[10] to produce the level of force desired to overcome resistance or gain the compliance of a non-compliant subject. The faster a police baton is swung, for example, the greater potential of injury to the impacted target. The same physical reality applies to impact munitions, albeit in a different domain. Once impact munitions are fired, they quickly reach their maximum velocity, then start to loose velocity as they travel to the target. The shorter the distance from muzzle to target, the greater the velocity of the projectile upon impact. The greater the velocity, the greater the amount of kinetic energy delivered to the impacted target. As the amount of kinetic energy increases, so too does the potential for injury. Conversely, as the distance from muzzle to target increases, kinetic energy and injury potential decreases.

In order to get some sense of what the data we collected showed about the relationship between distance and injury, we examined the injuries subjects suffered from projectiles fired at different distances. Table 5 below cross-classifies the seven injury classifications we used by the six increments of distance we previously presented (i.e., 10 foot increments to 49 feet, and 50 or more feet) for the 655 impacts for which respondents provided information on both distance and injury.

Table 5: Cross-Classification of Distance and Injury for 655 Munitions Impacts

	Injury	*Sustained*						
Distance	Bruise	Abrasion	Laceration	Fracture	Penetration	Death	None	**Total**
Below 10 ft	23	13	1	5	---	1	8	51
10-19 ft	124	61	13	8	6	1	10	224
20-29 ft	81	61	14	4	2	4	7	171
30-39 ft	56	48	4	6	4	---	13	131
40-49ft	25	11	1	1	---	---	5	43
50 ft plus	24	3	3	2	2	---	---	34
Total	333	197	36	26	14	6	43	**655**

A look at the first two columns of Table 5 indicates that the vast majority of injuries sustained from all distances consist of bruises and abrasions. Indeed, more than 70% of the cases at each distance increment include wounds of one of these two types. Another point of interest concerns projectiles fired from less than 10 feet from subjects. Almost 10% of the impacts from this distance produced broken bones, by far the highest fracture rate across the several distances considered. Another point of interest is that all six of the fatalities in the table came from projectiles that were fired from less than 30 feet. Respondents did not provide distance information for the other two cases that resulted in subject's death, unfortunately, so we can not say whether subjects are more likely to sustain fatal injuries when impacted from within 30 feet as compared to when they are struck by projectiles fired from greater distances.

A second important matter where possible correlates of injury are concerned is the area of the body where munitions impact. Manufacturers' literature and impact munitions training programs typically advise officers to direct their aim towards certain areas (e.g., extremities and larger muscle areas) and away from others (e.g., head, neck, spine, liver and kidney areas) based on the

[10] Kinetic energy is the energy possessed by a body (projectile) because of its motion, equal to one half the mass of the body times the square of its speed.

assumption that more serious injuries are more likely to occur when subjects are struck in the former areas. (Defense Technologies Corp. of America product data sheet, 1999; California Association of Tactical Officers Training Manual, 1998). To shed some empirical light on this matter, we conducted additional analyses that examined the injuries that subjects sustained when struck in specific areas of their bodies. Table 6 below cross-classifies each of the nine body areas we utilized by the seven types of injuries we considered (including no injury) for the 768 munitions impacts for which respondents provided data on both area impacted and injury sustained.

Table 6: Cross-Classification of Area Struck and Injury Sustained for 768 Munitions Impacts

	Injury	*Sustained*						
Area Hit	Bruise	Abrasion	Laceration	Fracture	Penetration	Death	None	**Total**
Abdomen	158	62	8	9	2	---	14	254
Chest	69	49	3	6	6	5	7	146
Back	46	29	2	1	---	---	6	84
Groin	4	---	---	---	---	---	2	6
Leg	56	33	11	---	3	---	10	113
Arm	42	48	11	6	1	---	7	115
Buttocks	15	11	---	---	---	---	1	27
Head	3	2	7	5	2	---	---	19
Neck	1	3	1	----	---	1	---	5
Total	394	237	43	27	14	6	47	**768**

Two points stand out in Table 6. The first is that impacts to the head tend to produce a greater proportion of serious injuries than impacts to any other area of the body, with 14 of 19 head impacts causing either a laceration, a fracture, or a penetrating wound. The second point is that five of the six fatalities for which we have clear information on the body area impacted, were due to projectiles that struck subjects in the chest. In the two other fatalities that were caused by impact munitions, the subjects were hit by multiple rounds that struck different areas of their bodies. Because it was not possible to conclusively attribute either of these deaths to a projectile strike on a specific body area, neither of these cases was included in Table 6. Summaries of all cases in which subjects died, including the two caused by miss-loaded lethal rounds, are presented below, beginning with the single death stemming from a neck impact.[11]

[11] We also examined injury patterns in terms of other variables, such as the type of clothing the subject was wearing and munitions type. Such analyses did not produce much notable fruit (due to factors such as no clear patterns where clothing is concerned and small N's for some types of munitions). We also grouped injury type in a variety of configurations and estimated a variety of multivariate models in an attempt to isolate the independent effects of specific factors. For example, we classified death, penetration, and fractures as "serious" and all other injuries as "not serious" for logit modeling and crafted an ordinal injury measure with no injury at the bottom and fatality at the top for use in OLS modeling. These attempts at multivariate modeling also yielded little fruit, as the number of missing cases grew substantially as we added predictors to the models.

Synopsis of Deaths

The sample of cases in the current study included all known deaths attributed to the use of impact munitions (or in the two cases involving of the miss-loads, the use of what officers thought were impact munitions) in North America as of May 30th, 2000.[12]

1. A 42-year-old male who stood approximately 5'10" and weighed approximately 165 lbs engaged in an altercation with several officers. After the officers had used an electronic "TASER" 22 times with no effect, they fired several 37mm foam rubber and 37mm bean bag rounds at the subject (a total of 13 combined). One bean bag struck the subject in the throat. He died weeks later as a result of the impact to the throat. (Control # 96)

2. A 60 year-old male (5' 4", 160 lb.) was struck three times with ARWEN AR1 37mm PBR's from approximately 10 feet; once in his left arm, and twice in his chest. One of rounds impacting the subject's chest fractured a rib, a portion of which penetrated his heart and one of his lungs. (Control # 70)

3. A 61 year-old female (5' 4", 110 lbs.) was struck once in the chest with an ARWEN AR1 PBR round from approximately 9 feet. The impact fractured a rib, which penetrated the subject's heart and one of her lungs. (Control # 87)

4. A 34-year-old male (height and weight unknown) was struck twice in the chest with 12 gauge bean bags from approximately 21 feet. One of the bean bags broke two ribs, penetrated his chest cavity, and lodged in his heart. (Control # 131)

5. A 29-year-old male (height and weight unknown) was struck with five (5) 12 gauge bean bags from 21 – 30 feet. The last round, fired from approximately 26 feet, penetrated his chest and punctured one of his lungs. (Control # 286)

6. A 68 year-old male who weighed some 270 lbs was struck by a total of more than 100 KO1 plastic batons, foam rubber, wood, and bean bag munitions from a distance less than 20 feet. He succumbed to the injuries 18 months later. (Control # 383)

7. A 22-year-old male who stood approximately six feet tall and weighed approximately 200 lbs was struck one time in the chest with a 12 gauge bean bag round from a distance of 21 feet. While, the official cause of death was still pending at time of this report, the case is included for the sake of thoroughness. (Control # 408)

8. A 30-year-old male (approximately 5'9", 257 lbs.) was struck several times in the head, neck, and chest with KO1 PBR's. The autopsy report identified the cause of death as blood clots due to blunt trauma to the head, coupled with respiratory distress from chemical agent (CS) exposure. (Control # 256)

[12] The literature includes a reference to the 1971 death of a citizen at the hands of the police that was caused by one or more strikes by impact munitions. Because we could not verify any details about this incident, it is not included in the current study.

9. A 42-year-old male died after being struck in the chest when a lethal 12 gauge door-breaching round that was loaded by an officer who believed that the shotgun shell in question contained a bean bag projectile. (Control # 37)

10. An 18-year-old male was accidentally killed when he was struck in the chest by a 12 gauge barricade penetrating OC projectile that was miss-loaded in place of a bean bag projectile. (Control # 257)

Lethal Force

In addition to the subjects who died from wounds incurred via impact munitions (or what were initially believed to be impact munitions), several other subjects included in this study died from lethal rounds that officers *intentionally* fired when the impact munitions proved ineffective. We did not specifically seek information on the use of lethal force in the study, but our review of the case narratives disclosed 26 cases where respondents reported that officers used deadly force after the application of impact munitions failed to bring the incident to a less unfortunate end. Because we did not seek information on the use of deadly force, it is possible that it was used in more than the 26 cases we identified. Based on the nature of the reports offered in the narratives, however, we suspect that the 26 cases constitute all of the cases in the sample where deadly force was used. Whatever the case might be, it is clear that officers ultimately used deadly force to resolve at least 7% of the cases where they fired impact munitions at subjects.

CONCLUSIONS

That impact munitions do not always succeed in accomplishing their intended goal of resolving violent and potentially violent police-citizen encounters short of deadly force indicates that these law enforcement tools are not a panacea. Impact munitions are not 100% effective in resolving the crisis situations in which they are employed. Police officers who decide to deploy weapons containing such projectiles during confrontations with dangerous subjects need to ensure that they have additional force options, to include lethal force, readily available. This would facilitate in protecting themselves and other innocents in case the impact munitions do not have their intended effect.

The sub 100% effectiveness, combined with the eight deaths attributable to impact munitions, suggests a second conclusion: The on-going search for effective less-lethal weapons for law enforcement use should continue apace. In the recent past, some "next generation" impact projectiles and delivery systems have become available to American law enforcement. These include new types of bean bag projectiles, 40mm "sponge" rounds, and the "Pepper-Ball" system. The Jaycor "Pepper-Ball" system, which is displayed in Photo #4, consists of a modified recreational "paintball" launcher configured to fire projectiles containing OC powder that are designed to rupture upon impact, delivering a blow to the subject and dispersing the chemical irritant on and around his or her body. One of the new bean bag designs is the Combined Tactical Systems (CTS) "Super Sock" round. The CTS 12 gauge bean bag consists of a fabric bag filled with 42 grams of lead shot

and tied off in the middle to contain the lead shot (see Photo #5). Where so called "sponge rounds" go, Defense Technologies "Exact Impact" round is receiving considerable attention from law enforcement. This 40mm projectile is made from high-density sponge material and appears to deliver two very important requirements, long-range accuracy and consistency. (see Photo #5).

Photo #4
Jaycor Pepper-Ball System

Photo #5
Combined Tactical Systems
12 ga. "Super-Sock" (shell at top and projectile in middle) and Defense Technologies "Exact Impact" 40mm round.

Independent tests conducted by members of the San Diego Police Department and National Tactical Officers Association. (NTOA) indicate that both the "Super Sock" and "Exact Impact" rounds are more accurate than other 12 gauge and 37/40mm projectiles, respectively. Unfortunately, the current study can not offer any useful information about how these "next generation" munitions perform in the field because they have only recently come on line.

Fortunately, the current study did develop enough information to draw several other conclusions about the usage and effects of impact munitions. To wit:

1) Impact munitions are safe as measured against the likelihood of fatal injury when officers shoot citizens with lethal munitions. Research indicates that in recent years almost half of the of the citizens shot with standard police ammunition succumb to their wounds (e.g., Hutson et al., 1998; Geller and Scott, 1992)[13]. With just eight deaths attributable to (actual) impact munitions in 372 cases where at least one projectile found its intended mark, it is clear that impact munitions rarely produce fatal injuries. As noted above, the current data includes all known

[13] Hutson et al. provides the most expansive recent information on fatality rates. They report that 46% of the subjects struck by standard ammunition fired by Los Angeles County law enforcement officers (except those employed by the LAPD) during the 11 year period ending in 1997 died as a result of their wounds. Geller and Scott (1992:97-100) report a broad range of fatality rates -- from 18% to 88% -- in officer-involved shootings across several other jurisdictions and time periods.

deaths in North America caused directly by impact munitions strikes as of May 2000, but no where near the entire population of cases where officers shot citizens with impact munitions up to that date. Consequently, the percentage of cases where citizens struck by impact munitions die is substantially lower than the 2.2% figure yielded from the present data. In sum, the likelihood of death from being shot by impact munitions is extremely low, particularly when considered against the alternative of being shot by standard police ammunition.

2) Impact munitions are effective as measured by the standard of resolving high-risk encounters without having to resort to deadly force. In the current data, 93% of the incidents investigated were resolved with no lethal rounds fired.

3) Training in the proper use of impact munitions is critical. That two citizens died because law enforcement officers shot them with lethal ammunition that was mistakenly loaded into shotguns indicates that officers must be trained to be certain that the projectiles they are about to fire in circumstances where deadly force is not appropriate are indeed impact munitions.

4) Impact munitions should be clearly identifiable. Reviews of the two cases where citizens were mistakenly shot with lethal rounds indicated that the shotgun shells carrying the particular rounds involved are quite similar in appearance to the shotgun shells that contain the specific impact munitions fielded by the agencies in question. This information clearly suggests that the likelihood of accidental death due to miss-loading could be reduced by making impact munitions more clearly identifiable. Currently, numerous sorts of lethal projectiles are ensconced in shells that look very similar to those containing some types of impact munitions. Impact munitions developers and manufactures have historically been very receptive to law enforcement's needs and recommendations. Perhaps industry standard markings or coloring could be established to meet the need to avoid accidental deaths due to miss-load.

5) Impact munitions can save lives. Deadly force could reasonably have been used in nearly all of the incidents involving subjects armed with deadly weapons (nearly 90% of the cases) had impact munitions not been available. Because lethal force was indeed used in just 26 of these cases it is clear that impact munitions played an important role in bringing many potentially fatal police-citizen encounters to a more desirable resolution.

6) Law enforcement agencies should be more active in collecting detailed and accurate information relating to the deployment of newer types of use-of-force tools such as impact munitions. Many agencies contacted in this study, collected very little or could not readily access data for the use of impact munitions by members of their agencies. Many law enforcement agencies were unwilling to voluntarily participate in this study. One such agency is perhaps the largest user of impact munitions on citizen, but upper administrators declined their agencies participation.

Finally, the current study offers but the first large-scale empirical glimpse at impact munitions usage in American law enforcement. While we were able to collect information on a large number of cases, many agencies that use impact munitions did not participate in this study and many of the reports submitted by the agencies that did were incomplete. These two factors limited the scope of the

current research. Hopefully, future research will be able to collect more comprehensive data and thus shed even greater light on the use and effects of impact munitions.

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MK Ballistic Systems
1995 Product Data Sheet

APPENDIX 1. DATA COLLECTION INSTRUMENT

Less Lethal Munitions Report Form

Agency | Address | Contact Person

Phone | Fax | Email

Agency Size *Circle* 1 - 99 100 - 499 500 - 999 1000 - 4999 5000+ | Agency Type *Circle* Municipal Sheriff State Federal Other

Date of incident | Time Started | Time Ended

Incident Type *Circle* Civil Disturbance, Suicidal Susp. Violent Susp. Barricade, Warrant Serv. Hostage Inc. Other

Suspect's Name | Suspect's Weapon(s)

Age | Sex | Height | Weight | Race | Build Hvy Musc Med Thin

Suspect Wearing Heavy Clothing? Y/N | Describe Suspect's Clothing

Less Lethal Rounds Fired | # Less Lethal Rounds Hit | Copy of Incident Report Attached Y/N

Medical Exam. Y/N | Admitted to Hospital Y/N | Admitted to Hospital for Psychiatric Y/N

Diagram of Scene Attached Y/N | Photos of Injuries Attached Y/N | Suspect under influence of Drugs or Alcohol Y/N

Ammo used, Area hit, Distance fired, Injuries & Effectiveness **Examples**:

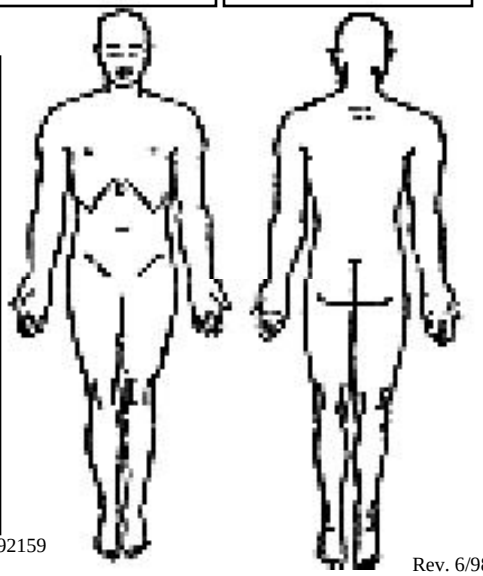
#1 MK 12 Close Range	Arm	20 feet	Laceration	No Effect
#2 KO1LE	Stomach	40 feet	Bruise	Gained Attention
#3 MK 12 Standard	Back	30 feet	Abrasion	Gained Compliance

#1					
#2					
#3					
#4					
#5					
#6					

Additional LL rounds fired listed on back of form Y/N

Synopsis of Incident

Continued on Back Y/N



Send to Calif. Assn. of Tactical Officers, Ken Hubbs PO Box 191462 San Diego, CA 92159
E-Mail CATO@home.com

Rev. 6/98

APPENDIX 2. Contact information for all manufacturers providing customer lists, or mentioned in this report, or both.

1. Combined Tactical Systems, Inc. 338 Kinsman Rd. Jamestown, PA 16134, (ph) 724.932.2177

2. Defense Technologies Corp. of America, 13386 International Pkwy. Jacksonville, FL 32218 (ph) 800.733.3832

3. Federal Laboratories, An Armor Holdings Company 13386 International Pkwy. Jacksonville, FL 32218, (ph) 800.733.3832

4. Jaycor, 9775 Towne Centre Dr. San Diego, CA 92121, (ph) 858.552.3510

5. Mace Security International, An Armor Holdings Company 13386 International Pkwy. Jacksonville, FL 32218, (ph) 802.447.1503

6. MK Ballistic Systems, 2707 Santa Ana Valley Road Hollister, CA 95023, (ph) 800.345.1504

7. Royal Ordnance, Police Ordnance Company, 22 Riviera Dr.Markham, Ontario, L3R 5M1 Canada (ph) 905.479.2223

8. Royal Arms International, PO Box 6083, Woodland Hills, CA 91365, (ph) 818.704.5110

9. Sage Control Ordnance, 6340 North Sage St. Oscoda, MI 48750, (ph) 517.739.2200