The Relationship Between Firearm Design and Firearm Violence

Handguns in the 1990s

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IN 1994, an estimated 39,720 persons died from firearm-related injuries.1 Fire-arms now rank a close second to motor vehicles as a cause of traumatic death nationwide. This convergence results not so much from an increase in the firearm-related death rate, which has remained relatively stable for the past 15 years, as from a steady decrease in the death rate from motor vehicle injuries.2 That decrease stems in large part from an explicit focus on the contribution to motor vehicle death rates made by the design and marketing of motor vehicles themselves.3,4

The purpose of this article is to help extend that product-oriented focus to the prevention of firearm-related injuries and violence by identifying those trends in the design and marketing of firearms that affect rates of firearm-related injury and violence or appear likely to do so in the near future. Many authors have argued that such an approach, building on its clear success in preventing motor vehicle injuries, would be of significant benefit.5-9 It is not the intent of this article to advocate a particular product-based policy agenda, but rather to inform the policymaking process. The main focus will be on handguns, which are disproportionately involved in firearm violence.

THE CHANGING NATURE OF HANDGUNS INVOLVED IN INJURY AND VIOLENCE

Handguns are of 2 major types: revolvers and semiautomatic pistols.

Revolvers typically carry 5 or 6 rounds of ammunition, which is stored in a rotating (or revolving) cylinder. Semiautomatic pistols carry their ammunition in a detachable magazine that usually fits into the grip of the gun (the part held by the user). Their ammunition capacity is variable. A semiautomatic pistol reloads automatically when fired, but its trigger must be pulled again to fire it a second time; fully automatic firearms reload and fire continuously if the trigger is pulled and not released.

For fatal shootings and nonfatal violence alike, semiautomatic pistols have increasingly replaced revolvers among crime-involved firearms. In most locations this transition became clear in the late 1980s; nationwide data do not exist.

In Chicago, Ill, the proportion of firearm-related homicides involving semiautomatic pistols grew from 15% in 1986 to 46% in 1992.10 Among gang-related homicides in Los Angeles, Calif, the proportion involving semiautomatic pistols rose from 5% in 1986 to 44% in 1994.11 In Milwaukee, Wis, 9-mm semiautomatic pistols were involved in 7% of firearm homicides in 1990, but 23% in 1994.12

In Philadelphia, Pa, the proportion of firearm homicides involving semiautomatic pistols varied between 24% in 1986 and 39% in 1990.13 This increase mostly involved medium- or large-caliber weapons; pistols of 9-mm or greater caliber were involved in only 4% of homicides in 1985, but 26% in 1990. These developments were accompanied by a surprisingly large change in the clinical course of eventually fatal shootings: For revolver homicides, at-scene mortality was 42% in 1986 and declined to 18% in 1990. In contrast, at-scene mortality for homicides involving semiautomatic pistols rose from 5% to 34% during the same period.

Reports from major cities document a contemporaneous increase in the overall severity of firearm-related injuries. The transition from revolvers to pistols is considered a key factor by many observers. At 1 Washington, DC, trauma center, the proportion of patients admitted for treatment of gunshot wounds who had more than 1 entrance wound rose from approximately 25% in the early 1980s to approximately 40% by 1990, a trend accompanied by an increase in inhospital mortality.14 In Chicago, where only 5% of admitted patients had been shot more than once in 1984, the proportion had risen to 20% by 1988.15

Numerous media reports of individual shootings have reinforced in particular the sense that high-capacity medium- and large-caliber pistols have become the nation's most important crime guns, but criminal justice statistics, which report on firearms involved in crimes of all types, paint a somewhat different picture.

On 1 hand, these data confirm the recently established predominance of pistols over revolvers. Among firearms confiscated by the police in Washington, DC, for example, revolvers outnumbered semiautomatic pistols by a ratio of 2:1 in 1987; by 1991 pistols outnumbered revolvers by 1:3.16 As recently as 1990, 2 of the 3 handguns most frequently traced by the Bureau of Alcohol, Tobacco, and Firearms (ATF) in response to requests from law enforcement agencies were Smith & Wesson (S&W) revolvers. By 1995, the 7 handguns most frequently traced by ATF were pistols (unpublished data, ATF, 1996). However, inexpensive, easily concealable, small- to medium-caliber pistols appear most often in criminal justice statistics. In California in 1993, 8 of the 10 handguns most

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frequently confiscated in a criminal context by a law enforcement agency were such pistols; all 8 came from 1 of 5 Southern California manufacturers known as the Ring of Fire companies. Of the 7 pistols most frequently traced by ATF in 1995, 6 were inexpensive guns from 1 of these Southern California manufacturers (unpublished data, ATF, 1996). The estimated number of each manufacturer's firearms in circulation was controlled for, guns from the Ring of Fire companies were 3.4 times as likely as those from other major manufacturers to appear in ATF's tracing data.9

THE CHANGING NATURE OF HANDGUN DESIGN AND MARKETING

Not surprisingly, trends in the nature of crime- and violence-involved handguns reflect general trends in the design and marketing of these consumer products. The most important of these trends is the emergence, for the first time, of the semiautomatic pistol as the dominant handgun design. In the early 1980s, US firearm manufacturers produced more than twice as many revolvers as pistols; by 1994, pistols outnumbered revolvers by more than 3:1 (Figure 1). The substantial growth in pistol production since the mid 1980s has been almost entirely to medium- and large-caliber guns (Figure 2).

The disparate findings of the medical and criminal justice statistics result from the development of 2 largely distinct classes of pistols. The first is made up of relatively expensive, large-capacity guns of a caliber of 9 mm or greater; their prominence in most studies of fatalities results in part from the higher wounding potential of their more powerful ammunition (Table).17,18 The second class is made up of small, inexpensive, small- and medium-caliber guns that are replacing earlier Saturday night special revolvers. The low price and easy availability of these guns have been implicated in their frequent criminal use.9 A third group is now emerging that combines the characteristics of the other 2 and takes advantage of recent technical innovations. These guns are designed specifically for the concealed-carry market. Many of them are simpler to operate than conventional pistols. Each of these groups will be discussed separately.

Large, Expensive Guns

The archetypal semiautomatic pistol is the Colt .45 ACP (automatic Colt pistol). Developed for the military before World War I and used by US armed forces until the mid 1980s, this pistol is still manufactured in substantial numbers by Colt and others. Since the introduction of Colt's original gun, these pistols have evolved in 4 areas that are reflected in current firearm violence or have implications for its future.

The first of these, paradoxically, was the development of less powerful pistol ammunition. Penetration of .45 ACP pistols into the civilian market was limited in part precisely because these weapons were so powerful. Pistols firing medium-caliber 9-mm ammunition were developed by the 1930s. They have largely replaced .45 ACP pistols in military service in the United States and are frequently used in law enforcement. During the past decade, growth in sales of 9-mm pistols has been explosive; domestic production of these guns increased more than 13-fold, to nearly 753,000 pistols, from 1985 to 1994 (Figure 2).

The 9-mm round was seen as not powerful enough by some users, and new large-caliber ammunition has appeared within the last decade. The 10-mm and .40 S&W cartridges are smaller than the .45 ACP cartridge but are comparable in estimated wounding potential (Table). Pistols designed to fire .40 S&W ammunition, described by 1 handgun manufacturer in 1994 as "clearly the hot new caliber of the future," are increasingly common.19 At least 3 firms now produce pistols designed to fire the .50 AE (Action Express) cartridge, developed in 1988. These guns have retained the ammunition capacity of the original Colt .45 ACP pistol but fire ammunition with much greater estimated wounding potential (Table). One of these pistols, the Desert Eagle, has appeared in a number of recent "action" movies. Production of large-caliber pistols has more than doubled, from 173,000 guns in 1992 to 351,000 in 1994 (Figure 2).

The second major development has been a substantial increase in larger pistols' ammunition capacity. The original Colt .45 ACP pistol carries 7 rounds of ammunition in its magazine. By 1994, manufacturers such as Springfield Armory and Para-Ordnance were producing .45 ACP pistols that retained the overall dimensions of the older gun but had doubled its ammunition capacity to 14 or 15 rounds. Many other manufacturers produced pistols carrying 11 to 13 rounds of .45 ACP ammunition. The Browning Hi-Power, perhaps the best known of the early 9-mm pistols, carries a 13-round magazine. By 1994, manufacturers including Sigarms, Taurus International, and Glock produced 9-mm pistols holding as many as 20 rounds. Other manufacturers produced accessory magazines with even greater capacity: 33 rounds in 9-mm pistols and 29

Figure 1.—Handgun production in the United States, 1980 through 1994, by handgun type (unpublished data, Bureau of Alcohol, Tobacco, and Firearms, 1996).

Figure 2.—Pistol production in the United States, 1985 through 1994, by caliber group (unpublished data, Bureau of Alcohol, Tobacco, and Firearms, 1996).
factured today are of what is called single-action design: For the gun to fire, its hammer must be cocked before the trigger is pulled. This is done manually before the first round is fired; the hammer is recocked automatically, and another round is brought into firing position, by the explosive forces of each discharge. For a single-action pistol to be ready for immediate use, it must be carried cocked and with a round of ammunition in the firing position; the safety is engaged to prevent unintentional firing.

Two relatively recent modifications of the operating mechanism, or action, of pistols have made them easier to use and therefore potentially accessible to a larger market. These operating mechanisms are referred to as double-action and double-action-only. Both mechanisms eliminate the need for the gun to be cocked manually; the first pull of the trigger cocks and then drops the hammer, firing the first round.

In conventional double-action pistols, the explosive forces of the first firing recock the hammer and bring a new round into firing position; the gun operates in single-action mode thereafter. The first (double-action) trigger pull is heavier than the single-action pulls that follow, which can be confusing to untrained users. After the user has finished firing, the gun remains cocked with ammunition in firing position unless it is empty. Such guns are equipped with a manually operated decocking device, which allows the cocked hammer to be lowered, without firing the gun. Many have other user-operated safety devices as well.

By contrast, in double-action-only pistols the explosive forces of each firing bring the next round into firing position, but do not cock the hammer. Many such guns carry no external, user-operated safety devices; these “slick-slide” guns are promoted as “more snag-resistant” for concealed-carry use. Their simplicity is seen by some as a strong advantage: “Just draw and shoot.” Their relatively long and difficult trigger pull has made them hard to control in some cases, and some early models have been unreliable. The absence of any user-operated safety devices in many of these guns has also caused concern.

With the exception of companies producing only the most inexpensive guns, every large manufacturer of medium- or large-caliber pistols now produces double-action and double-action-only models. Some industry analysts expect them eventually to dominate the handgun market; they approximate the ease of operation of revolvers but have a substantially larger ammunition capacity.

Finally, the past decade has seen a rapid increase in the use of polymer and other lightweight materials in this group of pistols. Polymer technology was popularized in the mid 1980s by Glock, a US-Austrian importer. Many manufacturers make extensive use of polymers in guns designed for concealed carrying, in which weight reduction is seen as an important advantage. Such guns can also be made less expensively, as machining costs are reduced.

### Small, Inexpensive Guns

One of the early variants of the modern semiautomatic handgun was the small-caliber, easily concealable, single-action pocket pistol. Guns of this type did not figure very prominently in firearm violence until relatively recently. Their emergence is the direct result of earlier policy efforts to control firearm violence.

In the late 1960s, rapidly rising rates of firearm violence were attributed to the easy availability of Saturday night specials. As defined in the 1970s by ATF, these guns were small (a barrel length of 3 in or less) and therefore easily concealable, cheaply made (a retail price generally less than $50) and therefore of low quality, and of small caliber (.32 or less). At that time such handguns were generally imported, and most of them were revolvers.

The importation of these guns was eliminated by the Gun Control Act of 1968. Under the provisions of the act, which are still in effect, imported handguns must meet minimum size criteria: pistols must measure at least 6 in long and 4 in high; revolvers must have a barrel at least 3 in long. Imported pistols must have a positive, manually operated safety, and all imported handguns must also achieve a qualifying score on a series of design and performance tests performed by ATF.

However, Congress deliberately exempted domestically manufactured handguns from these criteria. The effect was to create a protected industry, producing precisely the type of handgun associated with the violence that gave rise to the act in the first place. Today, the majority of these domestically manufactured Saturday night specials are pistols produced by the Southern California Ring of Fire manufacturers.

Compared with the earlier imported revolvers, these pistols are often smaller and therefore easier to conceal, yet have a greater ammunition capacity. The revolvers were typically 6 in or less in length, about 4 in high, and carried 5 or 6 rounds of small-caliber ammunition. The pistols that have replaced them are approximately 3.5 in high, under 5 in...
long, and designed to carry 6 to 8 small-caliber rounds. Other slightly larger pistols carry the maximum 10 rounds. To minimize labor and machining costs, manufacturers use a zinc-steel alloy for the frame of these guns that is reported to be so soft it can be shaved with a knife. Many of the guns sell for well under $100. Industry experts have repeatedly condemned these guns as inaccurate and unreliable for defensive purposes.9

Until the late 1980s, these manufacturers produced only small-caliber pistols. Beginning in 1988, 3 of the companies—Bryco Arms, Davis Industries, and Lorcin Engineering—began large-scale production of the medium-caliber .380 pistol. These guns are very similar in price, size, design, and manufacture to the small-caliber pistols, but fire ammunition with a substantially greater wounding potential (Table). As a result, .380 pistol production for the industry as a whole rose more than 12-fold, to more than 690,000 guns, from 1987 to 1993, before falling in 1994 (Figure 2). In that year several of these companies began production of 9-mm pistols; these guns are larger but share the earlier guns' low cost and, in the opinion of industry analysts, poor quality.30

The effective result of these developments has been the redefinition of the Saturday night special. In the 1990s such guns remain inexpensive and poorly made, but increasingly they are larger and more powerful than their predecessors.

Policy-based efforts to limit the availability of these guns have proved problematic. One oft-recommended measure is to require that handguns produced in the United States meet the criteria now applied to imports. According to ATF, most of these latter-day Saturday night specials would fail the minimum size standard, and many of the rest would fail the design and performance evaluation (E. Owen, written communication, June 8, 1994). At the time of this writing, the Senate was considering 2 bills (S1640, Bradley; S1654, Boxer) that embody this approach. Maryland has taken an alternative approach, establishing a Handgun Roster Board that must approve all handguns manufactured or sold in that state.31 The board considers design and performance characteristics along with utility for defensive purposes in reaching its decisions. An evaluation of the effectiveness of the Maryland statute has not yet been published.

The low melting point of the zinc alloy in these guns has been used in a few states to define firearms that are banned from sale. No data have been published on the effectiveness of these statutes.

Lorcin Engineering's new 9-mm pistol is made of an aluminum alloy that, according to the manufacturer, will pass this low-melting-point test.

The Immediate Future: New Concealed-Carry Guns

In 1987, Florida passed a “shall issue” statute that required law enforcement agencies to issue a permit to carry concealed firearms to anyone eligible to own guns and able to demonstrate some competency in their use. By the end of 1995, 28 states had enacted such statutes or in some other way had significantly eased access to concealed weapon permits.32 These new statutes created a potentially vast new market. Existing handgun owners might purchase another gun designed specifically for concealed-carry use; nonowners might purchase a first gun if it were sufficiently user-friendly. In 1995 a senior executive of 1 firm called the new laws “the most important star on the horizon” for the handgun industry.33

Technology and opportunity are now coming together. A rapidly growing number of manufacturers have introduced lightweight, easily concealable, double-action or double-action-only, medium- or large-caliber pistols; some smaller companies produce nothing else. The trend has given rise to a resurgence in what might be called “palmshot” advertising in gun consumer magazines, in which manufacturers emphasize photographically that their pistols can be hidden entirely behind the hand. Advertisements and promotional articles refer to these guns as “pocket rocket[s]” and “pocket battleship[s].”34,35 These new pistols retain substantial ammunition capacity: >7 to 9 rounds for medium-caliber guns (.380, 9 mm) and 5 to 7 rounds at larger calibers (.40 S&W, .45 ACP).

In 1995, major producers S&W and Glock introduced guns targeting this market. Smith & Wesson's gun, the double-action-only Sigma .380, is of particular significance. Made in part of the zinc alloy used by the Southern California manufacturers, it represents the first contemporary instance of a large, arguably high-end firearm manufacturer entering the low end of the market. The gun is targeted at “the utilitarian, even the reluctant, gun buyer who ... keeps a pistol for peace of mind.”36 As the first “expensive-name, low-price pistol,” it is predicted to be one of the hottest selling handguns of the decade.37

In addition to marketing entirely new guns, many pistol manufacturers have redesigned existing larger pistols to produce “compact” and “subcompact” models in which the barrel is shortened by an inch or more for concealed-carry use. And to facilitate concealed carrying of revolvers, manufacturers are reviving the “hammerless” or bobbed hammer design, in which the hammer is recessed entirely within the frame of the gun or rounded off to a lower profile so that it “can be drawn from purse or fanny pack without snagging.”38 Every major manufacturer of revolvers has added such guns to its product line in the past 3 years. The most recent introductions have been 5-shot .357-caliber guns.39

As with the latter-day Saturday night specials, many of these new and redesigned handguns are legally sold in the United States only because they are made here. The pistols frequently fail the minimum size criterion applied to imports. Some pistols, particularly the “slick-slide” double-action-only models, are not equipped with a user-operated safety as imported pistols must be. The new concealed-carry revolvers often have 2-in barrels, below the 3-in minimum for imports.

‘Point and Shoot’ Accessories

Two recently introduced accessory devices, both promoted as enhancing the defensive utility of handguns, may adversely affect firearm injury rates. The first is designed for large-caliber pistols and revolvers. The substantial recoil forces these guns generate has limited their popularity. They can now be equipped, at the time of manufacture or later, with a modification called a recoil compensator: 1 or more ports in the top of the barrel, near the muzzle, that redirect upward the flow of some of the escaping combustion gases. This is reported to reduce recoil by up to 50% and improve accuracy substantially.38,40

Recoil-compensated handguns can be carried concealed; the term in the industry is “carry comp.” Springfield Armory’s concealable compensated pistols, including an “ultra compact” version, are promoted as enabling the user to “engage multiple targets” with a firearm that is “manageable, even with the hottest self-defense ammunition.”41 No data on sales volume of recoil-compensated handguns are available, but aftermarket compensated barrels for many common high-caliber pistols are reportedly “selling like crazy.”39

The second accessory is the laser aiming device, now widely available and easily fitted to almost any contemporary handgun. These are about the size of an adult’s thumb or smaller and commonly are activated by a remote pressure switch installed on the grip of the gun. Lasers are seen frequently on firearms used in action movies.

One leading manufacturer claims that laser-assisted aiming allows “lightning-
fast target acquisition making it the perfect choice . . . for home defense.42 Sundance Industries, manufacturer of an inexpensive, laser-equipped .25 ACP pistol called the Lady Laser, instructs its users to "simply place the red dot on the target and shoot with precise accuracy and confidence."43

The industry itself is aware of risks associated with the use of laser aiming devices. They serve only to help fix the location of a potential target and cannot, as 1 leading industry writer puts it, "make certain that the person skulking around in the dark isn’t a member of [one’s] own family."44

CONCLUSION

As with any other consumer product, the design of handguns is evolving in response to changing consumer demand and the opportunities and limitations created by statute. This evolution will affect rates of firearm violence. The small-caliber Saturday night special is being replaced by inexpensive medium-caliber guns. The general trend toward higher caliber among handguns may well lead to an increase in the case-fatality rate for all types of shootings. The increased availability of handguns designed to be carried concealed in public may increase the number of shootings. Frequent depictions of laser-equipped and very high-caliber handguns in broadcast entertainment may lead to selective increases in their involvement in violence, as is believed to have occurred with both conventional pistols and assault weapons in the 1980s.

Current health and criminal justice surveillance systems are not capable of detecting these changes except where special efforts are being made. The case for establishing a comprehensive firearm fatality reporting system has been made previously in these pages.45,46 If we are to understand the relationship between firearms as products and firearm violence, such a system remains urgently needed.

If formulated without adequate data, future policies to control firearm violence can be expected to have both intended and unintended effects on the design and marketing of firearms; some of the latter may be counterproductive. Policymakers should consider adopting a comprehensive, rational, and continuing focus on product-based approaches to the prevention of firearm violence.

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References