TECHNICAL NOTE

John I. Thornton,[1] *D.Crim. and Ferdinand G. Rios,*[1] *M.P.H.*

The Effects of Deformed Shot on Shotgun Pellet Dispersion

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ABSTRACT: It has been previously proposed that the outliers of shotgun dispersion pattern are due to shot which are aerodynamically less stable as a result of impulse deformation at the instant of discharge. This has been confirmed by an experiment in which *all* of the shot are intentionally deformed before the loading of the shotshell. Any pattern of dispersed shot is therefore likely to be in part a result of a *shot packing factor* which describes the propensity of shot to be deformed upon discharge or to be cushioned against such deformation.

KEYWORDS: forensic science, ballistics, shotguns

Considerable effort has been devoted to the development of empirical and mathematical models to describe the dispersion of shot from the discharge of a shotgun. The dispersion of shot is clearly a function of distance, and the recognition of this relationship permits the determination of the distance between the firearm and the target at the instant of discharge.

The other variables of barrel length, pellet size, and extent of choke have also been evaluated as to their contribution to the total dispersion of shot [*1–3*].

In a previous paper [*3*], the present authors reported that the multivariate analysis of dispersion data following a latin square experiment indicated that at distances up to 15 m, 82% of the random variation of the data can be accounted for by a linear equation which incorporates the distance to the target as a variable. An additional 0.8% of this random variation is accounted for when barrel choke is added into the linear equation.[2] It was also found that for barrel lengths over 20-in. (51 cm) at distances between 10 and 20 ft (3 and 6 m), barrel length proved to be of minor importance in its effect on dispersion patterns. This is supported by the findings of other researchers [*4*].

The data developed by Rowe and coworkers [*2*] indicate that the dispersion of shot does not follow a linear model. As the distance to the target increases, the variance of the pattern increases, and the observed dispersion is therefore greater than what would be expected from

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[1]Professor of forensic science and graduate student, respectively, Department of Biomedical and Environmental Health Sciences, University of California, Berkeley, CA.

[2]This measurement is not the variation of the spread as a result of the various factors involved (that is, the distance or choke), but rather a reflection of the random variation within a series of measurements.

a linear model. This phenomenon is considered to be the result of deformed shot [5] with diminished aerodynamic stability forming the outliers of the dispersion pattern.

In the authors' previous paper [3], it was postulated that another factor, termed a *shot packing factor*, and related to the deformity of the shot, might account for an aspect of the dispersion.

Shotshell manufacturers have for years recognized the need to protect shot against deformation resulting from the impulse of discharge, and have incorporated either a fibrous cushion wad, a packing of granular polyolefin, or a collapsible polyolefin wad for this purpose.

The present work attempted to evaluate this shot packing factor, that is, a descriptor of the propensity of shot to be deformed at discharge. If, in fact, the outliers of an observed dispersion are those which are deformed, then a charge of shot in which *all* of the shot are deformed should show a greater dispersion than a charge of shot in which only a few are deformed. An experiment was devised in which this issue was tested.

Experimental Procedure

A series of two test-firings was conducted. A Stevens Model 94 Series P 12 gauge-shotgun was used; this firearm had a barrel length of 20-in. (51 cm) and a cylinder bore, that is, no choke constriction. The ammunition used was Winchester Super-X Long Range 12-gauge, 2 3/4-in. (7 cm), No. 6 shot, 1 1/4 oz. (35 g), 3 3/4 dr. eq. X126 powder. This ammunition has a fiber cushion wad with no granular polyolefin packing.

The distance from the muzzle of the shotgun to the target was maintained at 10 m. Large sheets of paper were used as target material.

For 1 series of test-firings, the ammunition used was taken directly from the box. For the other series, the end crimp was opened, the shot removed and deformed, the shot replaced, and the crimp closed. Each of the approximately 279 pellets was deformed by smashing them with a hammer. Figure 1 illustrates the general appearance of these purposefully deformed shot.

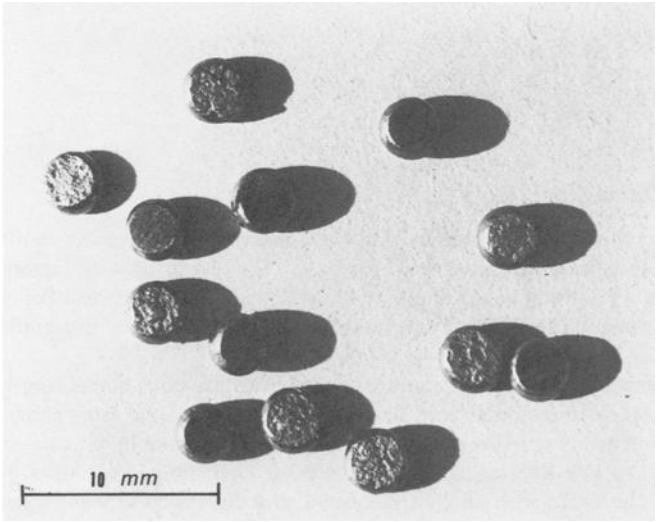

FIG. 1—*The general appearance of purposefully deformed shot.*

FIG. 2*a*—*Test-firing with factory ammunition that gave a pattern with a maximum diameter of 0.48 m.*

Results and Discussion

Replicate test-firings gave patterns that were consistent with respect to dispersion. The results of the test-firings are illustrated in Fig. 2. The test-firing with factory ammunition gave a pattern with a maximum diameter of 0.48 m (Fig. 2*a*). The test-firing with the deformed shot gave a pattern with a maximum diameter of 0.70 m with significantly greater dispersion (Fig. 2*b*).

In this experiment, the same shotgun was used, with the same barrel length, at the same distance, with the same number and size of pellets, and with the same choke constriction. The only difference between the two series of test-firings was that in one case, only a few shot are (presumed to be) deformed, while in the other case, all of the shot are known to be deformed. In the series with all shot deformed, the dispersion is seen to be substantially greater.

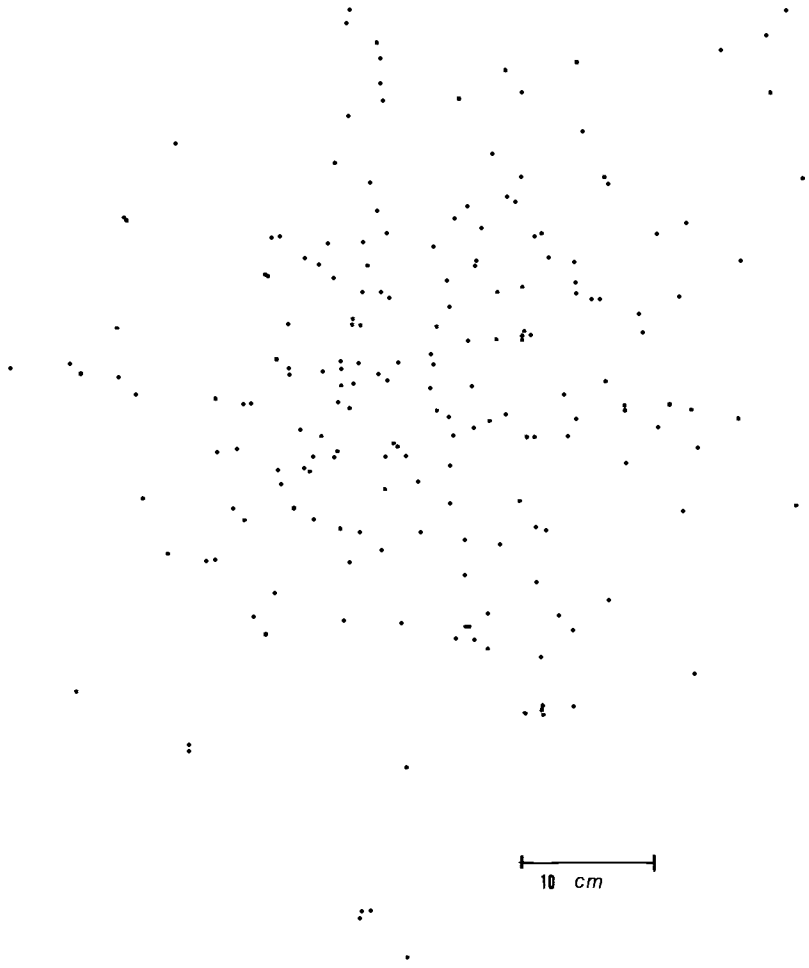

FIG. 2b—*Test-firing with the deformed shot that gave a pattern with a maximum diameter of 0.70 m with significantly greater dispersion than* 2a.

Conclusion

It is concluded from this experiment that the deformity of shot does in fact heavily influence the dispersion of shot. The manner in which the shot are packed in the cartridge will therefore be a factor in the overall dispersion of the shot, and shotshell ammunition in which the shot are more efficiently cushioned against impulse deformation are likely to show tighter patterns than those in which the shot deformation is relatively more pronounced. This underscores the imperative necessity of conducting discharge distance determinations with the identical ammunition used in the shooting incident being investigated, but it also indicates that shot packing is a factor which would have to be addressed in any prospective mathematical model explaining shot dispersion.

References

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Address requests for reprints or additional information to
Professor John I. Thornton
Forensic Science Group
Department of Biomedical and Environmental Health Sciences
University of California
Berkeley, CA 94720