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Trauma potential and ballistic parameters of cal. 9 mm P.A. dummy launchers

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ABSTRACT

Introduction: Blank cartridge actuated dummy launching devices are used by migratory bird hunters to train dogs to retrieve downed birds. The devices create a loud noise while simultaneously propelling a hard foam dummy for retrieval. A newly developed dummy launcher is based on a modified cal. 9 mm P.A. blank handgun with an extension tube pinned and welded to the barrel imitation. Currently, there are no experimental investigations on the ballistic background and trauma potential of these uncommon shooting devices.

Methods: An experimental test set-up consisting of a photoelectric infrared light barrier was used for measurement of the velocity of hard foam dummies propelled with an automatic dummy launcher.

Ballistic parameters of the dummies and an aluminium sleeve as improvised projectile (kinetic energy (E), impulse (p), energy density (E') and threshold velocity (v_{tsh}) to cause penetrating wounds as a function of cross-sectional density (S)) were calculated.

Results: The average velocity (v) of the dummies was measured 25.71 m/s exerting an average impulse (p) of 3.342 Ns. The average kinetic energy (E) was calculated 43.04 J with an average energy density (E') of 0.069 J/mm^2. The average velocity (v) of the aluminium sleeves as improvised projectiles was measured 79.58 m/s exerting an average impulse (p) of 2.228 Ns. The average kinetic energy (E) of the aluminium sleeves was calculated as 88.70 J with an average energy density (E') of 0.282 J/mm^2.

Conclusion: The energy delivered by these shooting devices is high enough to cause relevant injuries. The absence of skin penetration must not mislead the emergency physician or forensic expert into neglecting the potential damage from these devices.

1. Introduction

Hunting is a popular leisure activity and actively pursued by millions of people every year. It is in the nature of this activity that hunting related injuries or fatalities are mainly due to gunshot incidents [1–4].

Hunters use special gear and equipment that is widely unknown to persons who are not involved in these activities. Although forensic and traumatological experts are concerned with hunting injuries or fatalities from time to time, they are usually unfamiliar with the specific originalities of certain hunting gear.

Blank cartridge actuated dummy launching devices are used by migratory bird hunters to train dogs to retrieve downed birds. The devices create a loud noise while simultaneously propelling a dummy for retrieval. The dog is conditioned to ignore the explosive report of the muzzle blast and to wait for the hunter's command to retrieve the game.

Conventional dummy launchers are simple aluminium frame constructions that are provided with a handle and a firing assembly containing a chamber for a blank cartridge. The cartridge is fired by a firing pin and the dummy is propelled from the device. An advanced development of these conventional dummy launchers led to an automatic multi-shot launching device (Roehm Rapid Launcher) which is based on a blank cartridge alarm pistol and is widely used.

1.1. Technical data

The body of the Roehm Rapid Launcher (mass 860 g) is modified from the automatic gas and alarm pistol Roehm RG 96 by the way that an extension tube (launcher arm, outer diameter 13 mm, length 53 mm) is pinned and welded to the barrel imitation (Fig. 1). The Roehm RG 96 (approval number PTB 699) is a blank replica of the Heckler & Koch P8, which is the cal. 9 mm ×19 service pistol of the Federal German Armed Forces.

The muzzle of the extension tube contains two boreholes (inner diameter 4 mm) and is constructed in a deltoid pattern to avoid

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Fig. 1. Roehm Rapid Launcher. The extension tube (launcher arm) is pinned and welded to the barrel imitation and contains an o-ring to prevent gas pressure leakage before the dummy is launched. The muzzle contains two 4 mm boreholes (close-up figure).

Fig. 3. Aluminium sleeve (outer length 70 mm, outer diameter 20 mm, mass 28 g) cut out of the hard foam dummy. The open right end is imposed on the launcher arm.

muzzle loading and shooting of other projectiles (Fig. 1). In contrast to the Roehm RG 96, the Rapid Launcher has a double-action only (DAO) trigger mechanism.

The Launcher is operated with cal. 9 mm P.A.K. centerfire blank cartridges which contain a 0.15 g double-base (nitrocellulose and nitroglycerine mix) powder charge [5]. The ellipsoid dummy (mass 130 g, length 150 mm) itself is made of rigid foam and contains an aluminium sleeve which is placed on the launcher arm (Figs. 2 and 3). The opposite front surface measures 30 mm in diameter and contains a bore hole measuring 10 mm in diameter. In this bore hole a felt headpiece treated with drops of synthetic game scent can be inserted.

1.2. Legal background

According to the notice of assessment of Germany's Federal Criminal Police Office (Bundeskriminalamt, BKA) the Roehm Rapid Launcher is not a shotgun in its proper sense and is classified as non-gun [6]. The Launcher bears an approval test mark and approval number (PTB 795) of the German National Proof House (Physikalisch-Technische Bundesanstalt, PTB) [7]. Due to the reciprocal acceptance of approval test marks, these devices are also approved within all C.I.P. member states [8]. The Launcher and ammunition are available over the counter, age of consent (18 years) is the only legal restriction.

Fig. 2. Flat-nosed hard foam dummy (length 150 mm, front diameter 30 mm, mid diameter 50 mm, mass 130 g). The dummy is imposed on the launcher arm and propelled on a trajectory after discharge.

1.3. Aim of this investigation

For medico-legal assessment and traumatological treatment of injuries knowledge of the underlying injury mechanism and of the functional principle of the source of injury is mandatory. For injury risk assessment of shooting devices knowledge of specific ballistic parameters is indispensable. Currently, medico-legal and traumatological literature contains no information on these unique launching devices nor are there any investigations regarding their ballistic parameters. Therefore, it is the aim of this experimental investigation to provide these data.

2. Materials and methods

2.1. Test set-up

The experimental test set-up consists of a photoelectric infrared light barrier (CED M2 Chronograph System, Competitive Edge Dynamics Ltd., USA). Velocity of the hard foam dummies was measured between 1.0 m and 1.6 m from the muzzle.

In a second set-up, the aluminium sleeves were cut out of the dummies to serve as improvised projectiles (Fig. 3). Also, velocity of the aluminium sleeves was measured between 1.0 m and 1.6 m from the muzzle. For both test set-ups each 15 test shots were averaged.

For all test shots cartridges from the same ammunition lot were taken (cal. 9 mm P.A., Umarex, Germany). All measurements were taken in a completely enclosed shooting test stand free from weather influences. Calibration of the measuring system was performed before and after each series of measurements.

2.2. Data analysis and processing

The kinetic energy (E) of a projectile is half the product of its mass (m) multiplied by square of the velocity (v). Therefore energy of each dummy or aluminium sleeve was calculated by the formula $E = 0.5 \times m \times v^2$. Impulse ($p$) of the dummies or the aluminium sleeves was calculated by the formula $p = m \times v$. To determine the wounding potential of the dummies or the aluminium sleeves in case of a lengthwise (axial) impact of the dummy or sleeve head, the energy density (E') was calculated using energy and surface of the dummie's or sleeve's head.

On the assumption of a threshold energy density (E'_{tsh}) required for skin penetration of 0.1 J/mm^2, the threshold velocity (v_{tsh}) to cause penetrating wounds as a function of cross-sectional density (S) was calculated by the formula $v_{tsh} = (2000 \times E'_{tsh}/S)^{1/2}$ [9]. The cross-sectional density (S) was calculated by the formula $S = m/A$ (m projectile's mass, A projectile's face area) [9].

Statistical analysis was performed using SPSS 16.0.1 (SPSS Inc. Chicago/Illinois 60606).

3. Results

3.1. Ballistic parameters of the hard foam dummies

The average velocity (v) of the dummies was measured 25.71 m/s (range 24.1–27.8 m/s, sd (standard deviation) 1.2 m/s)