Deputy Commissioner Maciej Kuliczkowski, Ph.d.
Specialist, forensic laboratory, Police Commissariat in Wroclaw
Henry Juszczyk, M.Sc. Eng. (corresponding author)
Main Specialist, Central Forensic Laboratory of the Police
henryk.juszczyk@policja.gov.pl

Damage caused by projectiles shot from ZORAKI R1 model K-10 6 mm/10 mm calibre pistols

Summary

The article presents research conducted shooting at animal carcasses, animal shoulder bones, animal eyeballs, car body and windshield. Shooting was conducted using a ZORAKI R1 model K-10 6 mm/10 mm calibre revolvers and ammunition comprised of spherical and composite and rubber bullets and cartridges composite and 6 mm calibre Flébert rimfire blank cartridges. In some cases, ammo with an enhanced quantity of gunpowder was used. Studies have shown a danger to human life or health in the course of firing shots from a ZORAKI R1 model K-10 revolver at a person, in particular when shots are fired at a person's head.

Keywords revolver, bullet, cartridge, weighing gunpowder, shot, gunshot damage, impact energy, inlet, outlet, glass, scoop

Introduction

The article presents the course of studies and the results obtained during the shootings were carried out using a ZORAKI R1 model K-10 6 mm/10 mm calibre revolvers of Turkish production for the Polish company Kolter. Tests were conducted to determine the risks posed to humans by bullets fired from these firearms. It should be emphasized that the ZORAKI R1 model K-10 revolvers are adapted to fire a 10 mm calibre projectile using gas pressure generated while shooting 6 mm calibre Flébert rimfire blank cartridges.

Construction ZORAKI R1 K-10 6 mm calibre revolver

The ZORAKI R1 K-10 revolver is shown in Figures 1 and 2. The steel revolver has a barrel length of 63.5 mm (2.5 inches) and is in pinned, light metal alloy

Fig. 1. ZORAKI R1 K-10 revolver used in the study – view from the left side.

Fig. 2. ZORAKI R1 K-10 revolver – view from the right side.
housing (Fig. 3). The head of the pin appears on the upper surface of the barrel housing, before the sight. The inner cylinder of the barrel is 9.9 mm in diameter. The muzzle of the barrel does not have a partition, preventing the firing of bullets. On the upper side of the barrel, is visible, the internal cavity in which the end of the barrel locking pin fits the housing. The barrel of the gun, along with the housing, is mounted in the revolver frame. The tested revolver was equipped with a left pivoting cartridge drum that allowed the loading of its six chambers (Fig. 4) with wz. Flobert rimfire 6 mm cal. blank cartridges (from the grip) (Fig. 5) and 10 mm cal. rubber bullets (from the side of the barrel). The cartridge chamber was located at the rear of the drum. The depth of bullet chamber was 5 mm. In the axis of chambers of the drum there are partitions in the form of narrowings with a diameter of about 3 mm. In front of the drum there are six smooth-walled chambers having a diameter of 9.9 mm and a depth of 12.5 mm, in which the bottoms of the openings are elliptical in shape and a width of 5.5 mm, which channels communicate with the holes made in the bottoms of cartridge chambers, forming partitions. The channels connecting the chambers with compartments for loading cartridges to expand conically towards the outlet and have a length of approx. 21 mm. Chamber from side of the barrel (Fig. 6) allow the load to each of the bullet in the form of a sphere, rubber or composite. Firmly pressed, the projectile is in the chamber at a depth of about 5 mm from the front plane of the drum cartridge (Fig. 7). The total length of the bullet chamber is 38.5 mm. The front surfaces of the bullet chambers are milled in such a way that the cartridges sit with a projected flange and firing pin, which does not destroy the chamber walls in the case of so-called dry firing, without the cartridge introduced into the chamber. In the frame of the revolver mechanism is mounted the trigger assembly with an external tap. It works on the principle of single-action (single action), allowing firing by pressure on the trigger after manually cocking the hammer in the rear position and the system of double-acting (double action) when the pressure on the trigger results in cocking the hammer and releasing the hammer's firing pin. The revolver is fitted with mechanical sights. The revolver handle is covered with a two facings made of black plastic. The surfaces of the metal parts of the tested revolver are coated with black lacquer. The surfaces of the examined revolver is marked:

- "ZORAKI R1 MOD. K10" – on the right surface of the casing barrel
- "Made by ATAK ARMS Ltd. for” Kolter “ – on the right surface of the frame
- "KAL 6MM Flobert EKP <17J" — on the left surface of the casing barrel
- serial number of the weapon — on the bridge framing.

The ZORAKI R1 K-10 revolver is structurally adapted for firing shots with separate loading ammunition, which includes blank rimfire cal. 6 mm and Flobert cal. 10 mm cartridges. The fusion of these components of ammunition occurs in the chamber of the drum cartridge revolver, which firing caused the ejection of a standard Kolter caliber 10 mm spherical rubber bullet with a weight of 0.71 grams. The shots turned where made to the surface of the carcass covered with skin in the region of the front right shoulder and devoid of skin in the chest area. Ballistic tests were carried out on the shooting range in the open, in daylight, at 17°C with a medium cloudiness, no precipitation and little wind. The shots at pig carcasses was done from three different distances.

![Picture of a revolver](image6)

**Fig. 6.** A view of the cylinder chambers from the barrel.

![Picture of a rubber bullet](image7)

**Fig. 7.** The cylinder, loaded with rubber bullets.

**Shot fired from a distance of 3 m**

The bullet bounced off the surface of the skin, causing an indented round shape of a depth of 0.3 cm and a maximum diameter close to 10 mm (Fig. 9). As a result of the impact of the projectile there were no cracks in the skin and its penetration into the skin. In the lower part of the cavity is visible blackish precipitate deposited by the projectile as the ejected residue from blackened char from the barrel after the previous shot and the effect of the friction of the projectile, made of black rubber.

![Picture of a wound](image9)

**Fig. 9.** The effect of a shot from a distance of 3 m.

**Shot fired from a distance of 30 cm**

As a result of the shot, there was full penetration of the skin, wherein the projectile, inside the circular inlet opening having a diameter of close to 7 mm, stopped in the subcutaneous tissue. In the inlet opening, the projectile is visible under the skin (Fig. 10). Around the inlet opening is a smudge of approx. 3 mm. Subsequently, the bullet was removed from the skin.

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**Examinations shooting at animal tissues**

**Examination shooting at fresh pig carcasses**

The study used the forequarters of two pig carcasses (Fig. 8). The study used a ZORAKI R1 model K10 revolver and cal. 6 mm Flobert rimfire blank cartridges,
and a track of 1 cm depth was found, i.e. equivalent to the diameter of the projectile and its spherical shape. Following extraction of the bullet from the inlet opening, an oily substance as a thick liquid was extracted (Fig. 11).

![Fig. 10. Inlet. Visible rubber bullet.](image)

![Fig. 11. Gunshot track after removing bullet from under the skin.](image)

**Shot fired from a distance of 0.3 cm (shot from close range)**

The bullet punctured the skin, penetrated the centre and lodged under the skin. It created an inlet opening of round shape with a diameter of approx. 9 mm. Around the inlet opening was a visible edge of charred blackish material with a width of approx. 2 cm (Fig. 12) with single charred hairs growing on the skin around the hole. At the edges of the inlet opening there were three radial cracks on the sides and bottom of the inlet opening corresponding the tear in the skin. Subsequently, the projectile under the skin was removed, showing a track with a depth of 1 cm, i.e. corresponding to the diameter of the bullet (Fig. 13).

![Fig. 12. The effect shot from a distance of 0.3 cm.](image)

![Fig. 13. The inlet opening after removal of the projectile.](image)

**Examination of shooting at a slice of pork fatback covered with fabric**

The study used a square piece of pork fatback, 30 x 30 cm, consisting of the skin and subcutaneous fatty tissue of a total thickness of 15 to 30 mm. The slice of pork fatback was covered with a cloth and put on a foil cushion to stop the projectiles in the event of penetrating the pig fatback (Fig. 14).

The shot was made from a distance of 0.3 cm with a ZORAKI R1 K-10 revolver using the rimfire alarm cartridges of calibre 6 mm wz. Flbert and spherical rubber bullets with a weight of 0.71 g. The skin surface was covered with a piece of white cotton to improvise a shot to a body dressed in one layer of clothing, while capturing the characteristics shot at close range to the surface of the fabric.
The result was that the shot did not pierce the fabric. The projectile along with the fabric sank into the tissue below the level of the upper layer of skin. The surface of the rubber bullet and the area around the bullet was covered with blackish char (Fig. 15). The char was deposited in an area having a maximum diameter of 4 cm, with the darkest area of intense charring around the projectile in a circle having a diameter of 2 cm. Subsequently, the projectile along with the material was removed from the surface of the skin, noting that at this point there was a opening in the surface of the skin of a circular hole having a diameter of 10 mm and a length of approx. 13 mm and whose edges were curled to the inside (Fig. 16). On the edge of this hole was a short crack radiating from the edge of the hole, 3 mm long, being the beginning of the tear. It is one of the characteristics of a shot at close range. On the skin around the opening was a visible darkening of the surface from the ejected char from the penetration of the fabric.

Examination of shooting pig tissues with reinforced ammunition

The study used the long bone thigh sections of two pork forelegs covered with the soft tissues (muscles) and skin (shank) (Fig. 17). The shots were made in such a way that the bullets penetrated the most muscular places, there were no bones in the path of bullets.

The shot was fired from a distance of 1 cm using a ZORAKI R1 K-10 revolver loaded with a 6 mm wz. Flobert blank Rimfire cartridge and spherical rubber bullet with a mass of 0.71 g. Reinforced with black powder sample weight of 0.2 g

As the result, the rubber bullet created an inlet opening in the skin and penetrated the muscle, resulting in a blind channel. The shank was not penetrated. The shank at the point of the shot was about 7 cm thick. Around the inlet (Fig. 18), of an irregular shape and dimensions 5 x 5 mm, was a scorching line with a diameter of approx. 10 mm, around which were deposited ejected residues and a powder tattoo having a maximum diameter of 35 mm. On the opposite side of the shank is visible benign soft tissue swelling. Then, the channel introduced probe which stopped
at a depth of 43 mm. Subsequently, the skin coating was removed from the location of the shot. Below, there appeared a gunshot channel penetrating into the muscle, with visible traces of dark coloured char (Fig. 19). Subsequently, the upper layer was dissected free of muscle, and cut further muscle layers along the axis of the gunshot channel and ended with the resting sphere. The bullet stopped in muscle tissue under the skin, at a distance of 5 mm from the inside surface of the skin. The entire gunshot channel had a length of approx. 50 mm, and its edges were covered the entire length with ejected blackish char (Fig. 20). Microscopic study on the surface of the bullet removed from the bullet channel showed no damage or distortion.

**Fig. 18.** Damage as a result of the shot from the ZORAKI R1 K-10 revolver from a distance of 1 cm with ammunition containing reinforced black powder.

**Fig. 19.** Gunshot injury to the soft tissues after dissecting the skin coatings. Visible channel with traces of gunshot residue.

**Fig. 20.** An image of part of the clear gunshot channel in muscle tissues after dissecting the upper layer. The rubber bullet that stopped within 5 mm from the inner surface of the skin is visible, located on the opposite side of the shank. In the shot channel over its entire width can be seen gunshot residue.

Shot fired from a distance of 1 cm, with a ZORAKI R1 K-10 revolver loaded with a 6 mm calibre wz. Flobert rimfire blank cartridge and spherical composite projectile having a mass of 1.25 g, an enhanced weight of smokeless powder with a mass of 0.29 g.

To strengthen the shot was used colloidal sample weight of mixed grains of spherical graphite powder and cylindrical multi-channelled (perforated) of intermediate ammunition. A shot was fired at the most muscular part of the pork shank which along with skin coatings had a width of the about 7 cm (Fig. 21). The shot was delivered in such a way that the bullet did not hit the bone.

**Fig. 21.** Lateral view of the pork shank prepared for shooting.

It did not penetrate the pork shank. As a result of shot, the bullet was in the intake hole of about diameter 5 mm as well as penetrated into the interior of tissues. Around the inlet opening was an scorching
line with a diameter of approx. 9 mm. Around the inlet was visible blackish ejection residue on the surface, of dimensions 2 x 2.5 cm, and unburned and partially burned spherical grains of powder, which covered the inlet opening on the surface of the abrasion seam and penetrated into the inside of the channel (Fig. 22). Into the channel was introduced a gunshot probe which stopped at a depth of 45 mm. Next, in the skin and tissues of muscle were made an incision from the intake hole deep into along the axis of the course of the gunshot channel. After cutting the skin and soft tissues, there appeared to extend laterally, perpendicular to the long axis of muscle and bone, at the end of the blind gunshot channel, a stuck projectile (Fig. 23). The total length of the gunshot channel, measured to the face of the projectile, was 55 mm. After puncturing the skin covering, the bullet perforated muscles crosswise and fixed under the cover skin on the opposite side at a distance of 5 mm from it, i.e. lodged in the muscle tissue. Along the entire length of the channel are visible signs gunshot residue and unburned powder grains (Fig. 24).

![Fig. 22. Intake damage after the gunshot wound from distance 1 with cm with the composite projectile with strengthened smokeless powder. Visible is the inlet opening, scorching line, circle of residue and gunpowder grains in the gunshot channel.](image)

Examination of shooting at animal eyeballs

The study used fresh pork eyeballs supplied loose (Fig. 25). There was no mechanical damage to the eyeball prepared for testing. The study used a ZORAKI R1 K-10 revolver with rimfire blank cartridges of calibre 6 mm wz. Flobert and spherical rubber projectiles with a mass of 0.71 g. In the process of the examinations, the cartridges were not reinforced with extra gunpowder. In the course of the test, each eyeball was embedded in a pot, which contained a 26 mm calibre blank cartridge in the lower part of the casing of the cardboard body. The eyeball dimensions well suited the dimensions of the casing used, so that it was firmly seated and further extended over the top of the wall thereof (Fig. 26). The eyeball was set into the casing and placed in such a way that the pupil was directed upwards, it was visible and represented the area subject to firing.

![Fig. 23. Shank cut lengthwise. Visible course of the blind gunshot channel, with the bullet stuck at its ending. Gunshot channel walls covered with residue and grains of gunpowder.](image)

![Fig. 24. View of the gunshot channel.](image)

![Fig. 25. Eyeballs used in research.](image)
Fig. 26. The eyeball placed in the "pot" before firing.

As a result, the eyeball fell out of the pot and tore the cardboard wall. The rubber bullet tore the eyeball, bounced off the bottom of the pot and landed outside the interior. As a result of the missile impact, the intraocular fluid was expelled and covered the floor in the form of spray on the surface away from the eyeball at a maximum distance of 40 cm (the largest amount of spray was found at a distance of 20 cm from the eyeball) (Fig. 27). The walls of the cornea of the eye were broken, and intraocular fluid from the eye was deposited in the form of spots of liquid (Fig. 28 and 29).

Fig. 27. The effect of a shot from a ZORAKI R1 K-10 revolver to the eyeball. Visible are the splashes of intraocular fluid.

Fig. 28. Gunshot damage to the eyeball. Visible tears in its walls and outflow of intraocular fluid.

Fig. 29. Gunshot damage caused by the impact of the projectile. View after rotating the eyeball.

Fig. 30. Scapulae prepared for shooting.

Examination of shooting animal scapulae

The pork scapula, due to the properties of their structure and mechanical strength, are suitable for simulating human injuries to the flat bones of the skull, and may substantially mimic the human temporal bone of the skull. It is believed that a fresh sheep shoulder is the best in nature to replicate the side surface of a human skull due to their greater fragility, but the shots to a pig scapula, having slightly more flexibility, and hence mechanical resistance, the bullet hole will all the more provide information regarding similar injuries in temporal bones. For this purpose, shots were fired into pre-prepared fresh and cleared of meat from the blade (Fig. 30), assuming that the penetration of the bone will indicate the capability of the shot to the temporal bone of the skull. The bones were placed on a transparent cushion against further penetration of the bullets. The shots were made from a distance of 10 cm from the surface of the bone, in addition they were aimed at the flat part of the bone (without ridges).

inside the round inlet opening had the dimensions of 10 x 13 mm (Fig. 31) around which was visible a tattooing of gunshot residue particles of dark colour. The inlet opening drilled into the bone, ending at an outlet hole having elliptical edges cratered outwardly to the dimensions of 17 x 20 mm (Fig. 32). The bone in the place of the bullet hole had a thickness of 6 mm. The elliptical shape of the inlet and outlet testify to the fact that the bullet hit the bone at an angle, i.e. from bottom to top. At the edges of the crater outlet was shown the spongy interior structure of the bones, portions of which were flanged outwards (in accordance with the movement of the projectile). The rubber bullet, with factions of bone, pierced the foil pillow underneath the bone and rested in its first chamber (Fig. 33).

Fig. 31. Inlet of the bullet in the bone.

Fig. 32. Outlet of the bullet.

Fig. 33. Ejected particles and bone fragments and rubber bullet lodged in the first chamber of the film cushion.

The findings of the above examinations indicated that ZORAKI R1 K-10 revolvers loaded with standard cartridges and bullets dedicated to them, are gifted at causing injuries with the threat to health and human life, with shots directed of the human head from a distance of 10 cm.

Subsequently, studies were carried out shooting a ZORAKI R1 K-10 revolver using a spherical composite projectile of a weight of 1.25 grams and rimfire alarm cartridges of 6 mm calibre wz. Flobert, smokeless powder and weighing reinforced with a mix of graphite spherical and cylindrical multichannel (perforated) grains weighing 0.3 grams. Shots were made one after the other at a distance of 10 cm at the three scapula. As a result, the projectile penetrated two scapulae, which together with the pieces of bone fragments stopped on the top surface of the third scapula without causing damage (Fig. 34). The inlet bullet hole in the first bone was round with even edges and a diameter of 10 mm (Fig. 35). The inlet opening was covered with...
a significant number of unburned grains of gunpowder expelled from the barrel of the revolver. The gunshot channel of the first bone ended with a crater-shaped outlet hole of a round shape with a maximum diameter of approx. 25 mm (Fig. 36). In the walls of the crater was visible the structure of the spongy bone. The location of the damage to the penetrated bone had a thickness of 8–9 mm. Inside of this hole were damaged bone
the cavity was a visible black trace of round shape and a diameter of about 9 mm, from the rubber from which the projectile was made (Fig. 41). Paint pieces filled the indentation and firmly adhered to it (the paint at this point broke away with difficulty). The indentation is measured from the surface of the metal sheet and resulted in 1.7 mm. Cracks were present around the indentation and there was a loss of the lacquer coating, of an irregular shape, on the surface, with dimensions of 1.5 x 1.4 cm.

Then next shot was made from a distance of 2 m, which caused similar damage to the car body (Fig. 42). The bullet bounced off the car body, causing a cavity filled with circular fragments of paint with a diameter of 11 mm, formed by the spherical projectile. In the centre was a visible, round, dark sign of abrasion of the rubber sphere of the dimensions of 5 x 6 mm. The indentation in the car body metal measured from the edges of the cavity amounted to 1.8 mm. There was cracking around the indentation which caused paint defects on the surface, having dimensions of 1.7 x 1.3 cm, of a round shape and irregular edges.

Examination of shooting at a car body

The study used a ZORAKI R1 K-10 revolver, rimfire blank cartridges 6 mm calibre wz. Flouret and spherical rubber projectiles with a weight of 0.71 grams. The study was conducted with the use of a VW Golf car body. Shots were fired into the left door of the car (Fig. 40). The car body was covered with a blue paint finish. In the prepared place of the firing there was no apparent mechanical damage to the body metal or the lacquer coating.

The first shot at the door of the car was made from a distance of 10 cm. The bullet bounced off the surface of the body sheet metal without breaking through. The bullet caused a cavity in the body plate, a circular patch of paint with a diameter of 10 mm. On the surface of
Gunshot damage to the car body

Examination of shooting at the car window

The study used a ZORAKI R1 K-10 revolver with blank 6 mm calibre wz. Flobert blank rimfire cartridges and spherical rubber projectiles weighing 0.71 g. Shots were made to the side of the glass window of a FIAT 126p (Fig. 43).

The first shot at the car window was made from a distance of 5 m. The shot did not cause any damage to the glass.

The second shot at the window of the car was cast from a distance of 4 m. As a result, there was a round hole in the glass with a diameter of approx. 4.5 cm. The above damage consisted of numerous radiating cracks across the surface of the glass into small fragments in accordance with lineal feature of tempered glass (side window of the vehicle) (Fig. 44 and 45). In the edges of the hole there was no presence of cratered fragments of glass characteristic of gunshot damage to glass panes. Fragments of cracked glass with such damage were found inside the vehicle, indicating that part of the glass forming the edges of the inlet opening had been pushed inside the car by the projectile.

During the study it was found that:

1. The shot fired from a distance of 3 m to a carcass, using spherical rubber bullet with a mass of 0.71 g, caused a depression on the surface of skin, causing it to crack.
2. The shot fired from a distance of 30 cm in the carcass using a spherical rubber bullet with a weight of 0.71 g, caused a skin puncture and the projectile stopped in the subcutaneous tissue.
3. The shot fired at close range (approx. 0.3 cm) of a carcass using a spherical rubber bullet with a weight of 0.71 g, caused a skin puncture and the projectile stuck under the skin.
4. The shot fired at close range (approx. 0.3 cm) of a carcass covered with a piece of cotton fabric using a spherical rubber bullet with a weight of 0.71 g did not cause punctures to the fabric. The projectile, together with the cloth, sunk into the tissue below the level of the top layer of the skin.
5. The shot fired from a distance of 1 cm at the pig carcass using spherical rubber bullet with a mass
of 0.71 g, reinforced black powder sample weight of 0.2 grams, caused the puncture of the skin, and the bullet stopped inside the soft tissue at a depth of approx. 50 mm.

6. The shot fired from a distance of 1 cm at the pig carcasses, with a spherical composite projectile having a mass of 1.25 g and a reinforced weight of smokeless powder with a mass of 0.29 g caused a skin puncture and projectile stopped within the soft tissue, at a depth of approx. 55 mm.

7. The shot fired at an animal (pig) eye using a spherical rubber bullet with a weight of 0.71 grams resulted in the rupture of the cornea of the eye and extraction of the intraocular vitreous.

8. The shot fired from a distance of 10 cm at the flat surface of the pork scapula using a spherical rubber bullet with a mass of 0.71 g caused a puncture.

9. The shot fired from a distance of 10 cm in three pig scapulae (arranged one behind the other) using a spherical composite projectile having a mass of 1.25 g, reinforced weight of mixed grain graphitized spherical and cylindrical multichannel (perforated) smokeless powder used in the intermediate ammunition, weighing 0.3 g, caused a puncture in two scapulae.

10. The shot at the surface of the car doors from a distance of 10 cm and 2 m using a spherical rubber projectile weighing 0.71 g caused a depression in the surface, without puncture.

11. The shot given at hardened glass side door window of a car, using a spherical rubber projectile weighing 0.71 g caused a puncture at distances of up to 4 m (measured from the end of the barrel of the revolver to the surface of the glass).

The conclusions of the study

- The construction of the cartridge chambers of the above mentioned revolvers makes it easy to strengthen the ammunition with powder of a sample weight between a cal. 6 mm rimfire wz. Flobert blank cartridge and a bullet, which significantly increases the impact energy of the projectiles fired.

- Shots fired from ZORAKI R1 model K-10 revolvers, at close range, enable the piercing of skin and the penetration of soft tissues, the bursting of the walls of eyeballs and penetration of flat bones.

- Shots fired from ZORAKI R1 model K-10 revolvers are capable of piercing tempered a wind shield (from distances of up to 4 meters) and damage to the car body (cavities with losses of paint coatings).

- Using the ZORAKI R1 K-10 revolver against a human, consisting in firing a shot to the body, from close range, could put him in immediate danger of loss of life or grievous bodily harm, particularly in a shot directed towards the head.

Source

Figs. 1–45: authors

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