



CASE STUDY

PENETRATING CRANIUM INJURY BY A CONCRETE NAIL: CASE STUDY

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Abstract



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The article describes a case study, demonstrating the infliction of a single blind penetrating «gunshot» wound to the head with a concrete nail fired from a powder-actuated fastening tool. Forensic examination of the injury caused by atypical projectiles when fired from atypical firearms can be a difficult task. The results of a thorough autopsy examination of the body and the ante-/post-mortem discovery of atypical projectiles (or other foreign objects) in the victim's body are the prerequisite for correct interpretation of the injury morphological features.

Keywords: Atypical firearms, atypical projectile, cranium, gunshot wound, powder-actuated fastening tool.

INTRODUCTION

Penetrating head injuries caused by atypical projectiles can be countered both in clinical and forensic pathology practice. Commonly, difficulties in penetrating head injury forensic diagnosis arise when atypical or homemade firearms loaded with atypical ammunition (instead of standard bullets or pellets) was used. The literature describes the use of steel balls, the so called «chaff» (chopped fragments of steel wire or lead plates), small metal fasteners (rivets, nuts, washers, screws, bolts, nails), salt, fine gravel and sand, match heads, peas, grains, and fine-cut corn stems instead of standard buck shot¹⁻³.

The gunpowder propellant effect (the principle on which gunshot works) is used in construction and production fastening tools—powder-actuated tools (PAT), which allow direct bonding of various solid materials (low-carbon steel, reinforced concrete, concrete, bricks, wood). This technology is based on the controlled ignition and combustion of solid fine chemical fuel - the propellant charge of a mounting (construction, industrial) cartridge, similar to how a firearm works. The PAT is loaded with specially designed fastening cartridges with a powder charge, structurally similar to blank ammunition for firearms, and concrete nails as fastening tools.

The concrete nail was structurally composed of a wide flattened round cap, a cylindrical rod with a conically pointed end and a round flat metal gasket located at the pointed end of the rod that can be displaced when attaching. According to Russian technique specifications TU 14-4-1731-92, the concrete nails are commercially produced with the following dimensional parameters (rod width/length, cap width, gasket width): 3.7x30 mm, 3.7x35 mm, and 3.7x40 mm, 8 mm, 10 mm; 4.5x30 mm, 4.5x35 mm, 4.5x40 mm, 4.5x50 mm, 4.5x60 mm, 10 mm, 12 mm⁴.

The damage caused by concrete nails when fired from the PAT can be both accidental and intentional.

CASE PRESENTATION

The following case from the expert practice demonstrates the morphological features of a single blind penetrating gunshot wound to the head with an atypical metal projectile, which was a concrete nail 4,5x60 mm in size. A cranium with a perforating wound in the occipital bone and a spike-like protrusion of a foreign body in the frontal area on the left side was presented for forensic examination.

From the squama of frontal bone above the middle third of the upper edge of the left orbital socket, a conical end of the metal foreign body protruded from

the skull cavity to the outside 9 mm in length; its sharp end was oriented anteriorly, to the left and upwards (Figure 1). In the center of squama occipitalis, 26 mm from the apex of the external occipital tubercle, a perforating fracture of an oval shape measuring 16x15 mm was discovered (Figure 2). From the outer surface of the cranium, the edges of the perforating fracture are



Figure 1: A metal foreign body of a conical shape is protruding from the squama of frontal bone. Rightside view (a) and left side view (b).

In the frontal cranial fossa, a part of a metal foreign body with corroded surface was found. It was 32 mm long, and it was stuck in the squama of frontal bone (Figure 4a). Its axis was oriented posteriorly, from bottom to top and from right to left. The inner end of the foreign body (Figure 4b) was located in the area of the “cock’s comb” and the perforated plate of the ethmoidal bone. Under this part of the foreign body a splintered fracture with a bone defect, covering the area of 38x35 mm was found. From the right edge of the defect, 4 linear fissures up to 42 mm extended to the small wing of the sphenoid bone and to the squama of the frontal bone. A foreign body was extracted from the squama of frontal bone. It was a metal concrete nail

relatively even, without compact bone chipping (Figure 3a). There was an arc-shaped fissure 4-6 mm along the left half of the upper edge of the fracture. The fracture beveled from outside to inside. Inside the cranium cavity, the edges of the fracture had a prominent annular chipping, up to 3 mm wide (Figure 3b).



Figure 2: A perforating wound in the center of squama occipitalis.

59.4 mm long (Figure 4c). The cap was flattened, round, 10 mm in width, the gasket is flat, round, 12 mm in width. The nail’s rod was cylindrical, its cross section was round, 4.5 mm in diameter. The end of the nail’s rod was conical, with a round cross section, 2 mm in width at the tip, in its middle third - 3.5 mm. The parameters of the foreign body clearly attribute it to a fastening element - a concrete nail 4.5x60 mm in size (according to TU 14-4-1731-92⁴). After the extraction of the concrete nail, a perforated splintered fracture was revealed in the squama of frontal bone. On the cranium outer surface, it is round and limited by regular edge without compact bone chipping, with about 4, 5 mm in size (Figure 5a).

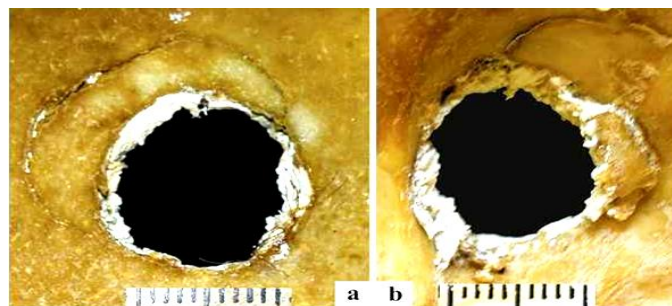


Figure 3: Perforating fracture in the center of squama occipitalis, outer surface view of the cranium (a) and from the inside (b).

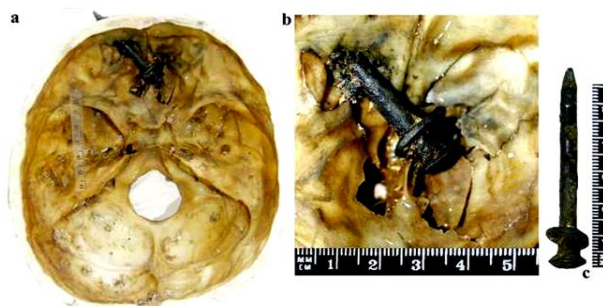


Figure 4: A metal foreign object stuck inside squama of frontal bone, discovered after cranium cavity dissection (a, b) a concrete nail 4, 5x60 mm in size (c).

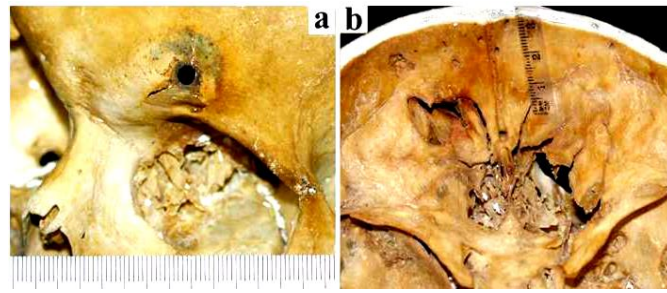


Figure 5: Perforated-fragmented fracture of squama of the frontal bone from the left side, cranium outer surface view (a) and inside the cavity (b).

From the inside, in the wall of the frontal sinus, there was a defect of an irregular polygonal shape, measuring about 15x18 mm (Figure 5b).

DISCUSSION

The described above morphological features of the perforated fracture of squama of frontal bone suggest the local fracture pattern as a result of shearing deformation caused by the contact (impact) force of a solid blunt object with a limited contact surface and having sufficient kinetic energy (speed) for penetrating action. Morphologically similar perforated fractures of the flat skull bones are verified as gunshot input bullet injuries^{1-3,5,6}.

The perforated-fragmented nature of the exit fracture is due to the anatomical structure of the squama of frontal bone of the local contact (impact) area (frontal sinus, brow arc), by an atypical nature of the projectile that initially had low travelling speed and had further reduction in kinetic energy (speed) after penetrating and passing through the first tough barrier (squama occipitalis), it is quite safe to assume, that the reduction of the projectile speed can be attributed to the structural features of the PAT from which the shot was fired, its distance and head position at the time of injury (for example, close contact with the frontal region of the head into a hard surface (concrete/brick wall, cement/wooden floor)⁶.

CONCLUSION

In this case, the discovery of an atypical projectile made it possible to correctly interpret the number, the nature and the features of the revealed injuries on the cranium, defining them as a single blind penetrating gunshot wound to the head with a concrete nail. The condition of this object did not allow determining the vitality of injury, neither to detect additional factors of the shot.

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AUTHOR'S CONTRIBUTIONS

Al-Turki AA: writing original draft, conceptualization, methodology, investigation. **Siamionau VV:** data analysis, report drafting. **Tsiatsiuyeu AM:** editing, review. All authors read and approved the final manuscript for publication.

DATA AVAILABILITY

The data supporting the findings of this study are not currently available in a public repository but can be made available upon request to the corresponding author.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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