FORENSIC MEDICAL ASSESSMENT OF SCALP WOUNDS CAUSED BY THE EDGES OF SHARP AND BLUNT OBJECTS

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Abstract

This article presents the results of an experimental forensic medical study of scalp wounds caused by the edges of sharp and blunt objects. The relevance of the study is обусловлена by the high prevalence of chopped and lacerated-contused head injuries in forensic medical practice, as well as by the need to improve diagnostic criteria for identifying the injuring instrument.

Keywords: forensic medicine, head trauma, chopped wounds, lacerated-contused wounds.

Introduction: Injuries to the scalp caused by sharp and blunt objects occupy a significant place in the structure of mechanical trauma investigated in forensic medical practice. Differential diagnosis of wounds formed by objects with varying degrees of edge or blade sharpness presents particular difficulty, since similar external features often complicate the determination of the mechanism of injury and the characteristics of the injuring instrument.

In modern forensic medical examination, it is important not only to establish the fact of mechanical impact, but also to determine the specific parameters of the injuring instrument, including its shape, sharpening angle, edge width, edge characteristics, and force of impact. The morphological features of scalp skin wounds are highly informative because the skin in this area is characterized by dense fixation to the aponeurosis, a rich vascular network, and specific biomechanical properties.

Despite the large number of scientific studies devoted to chopped and contused wounds, issues related to the forensic medical assessment of wounds caused by the edges of sharp and blunt objects remain insufficiently studied. In particular, the number of studies conducted under conditions of standardized experimental modeling using controlled kinetic impact energy and modern microscopic analysis methods remains limited.

In this regard, experimental studies aimed at investigating the patterns of scalp wound formation under the impact of various injuring objects are of considerable scientific and practical importance.

The aim of the study was to identify the morphological features of scalp skin wounds caused by the impact of various injuring objects with sharp, blunt, and rounded edges, as well as to determine their forensic medical diagnostic significance.

Experimental modeling was carried out on scalp skin flaps obtained from biomodels of both sexes aged 23 to 86 years during the first 24 hours of the postmortem period. Carpenter's axes, splitting mauls, and metal angular profiles with different cutting edge and rib characteristics were used as injuring objects. Injuries were inflicted using a pendulum impact device with fixed kinetic impact energies of 9 J, 19.3 J, and 31.1 J. A total of 216 experimental observations were performed.

The wounds were examined using visual, measuring, stereomicroscopic, and photographic methods with the use of MBS-10, Leica, and MS-2 microscopes. Additionally, restoration of skin preparations was carried out according to the method of A.N. Ratnevsky. Analysis of the trace formation kinematics was performed using digital video recording.

It was established that the morphology of injuries directly depended on the sharpness of the blade, edge width, rib shape, and the magnitude of kinetic impact energy. Sharp blades produced linear wounds with smooth edges and acute ends, whereas blunt and rounded edges resulted in lacerated-contused wounds with abrasion, tissue crushing, and pronounced tissue bridges in the depth of the injuries. An increase in impact energy led to an increase in wound depth, length, and the degree of soft tissue destruction.

The obtained results make it possible to determine a complex of morphological criteria that are of significant importance for the forensic medical diagnosis of injury mechanisms, identification of the injuring object, and reconstruction of the circumstances of injury infliction.

Materials and Methods: Experimental modeling of injuries was performed on scalp skin flaps obtained from biomodels of both sexes aged 23 to 86 years without visible signs of skin pathology or traumatic soft tissue changes. The study was conducted during the first 24 hours of the postmortem period.

The following injuring objects were used:

- carpenter's axes with sharp and artificially blunted blades;
- splitting mauls with sharp and blunted blades;
- metal angular profiles with pronounced and rounded edges.

To determine blade parameters, goniometric grids according to the method of D.A. Karpov and B.A. Sarkisyan were used. The blade edge width was determined by profiling with a narrowly directed oblique light beam.

Experimental impacts were applied using a fixed-structure pendulum impact device. The kinetic energy values were:

- 9 J — at a pendulum deviation of 45°;
- 19.3 J — at a deviation of 90°;
- 31.1 J — at a deviation of 135°.

A total of 216 experimental injuries were produced, divided into 6 series with 36 observations each.

The wounds were examined using:

- visual methods;
- measurement methods;
- stereomicroscopy;
- photography;
- graphical modeling;
- video recording of trace formation kinematics.

An acetic acid–alcohol–water solution according to the method of A.N. Ratnevsky (1:2:7) was used for restoration of skin preparations.

Results: The conducted experiments demonstrated that the morphological features of injuries differed significantly depending on the design and sharpness of the injuring object.

Wounds caused by axes with sharp blades were characterized by:

- linear shape;
- smooth wound edges;
- sharp wound ends;
- absence of pronounced abrasion;
- minimal tissue crushing.

When axes with blunted blades were used, the following features were observed:

- lacerated-contused character of injuries;
- irregular wound edges;
- presence of abrasions;
- tissue bridges;
- deformation of hair shafts.

Injuries caused by splitting mauls were accompanied by more pronounced soft tissue crushing due to the significant wedge thickness and larger sharpening angle. These wounds were characterized by:

- wide contusion zones;
- pronounced tissue delamination;

- deep aponeurotic defects;
- multiple skin microcracks.

Metal angular profiles with pronounced edges produced linear injuries with clear boundaries, whereas profiles with rounded edges caused predominantly contused and superficial lacerated injuries.

It was established that an increase in kinetic impact energy was accompanied by:

- increased wound length;
- greater wound depth;
- expansion of abrasion zones;
- intensified tissue deformation.

Conclusion: The conducted experimental study made it possible to establish the patterns of scalp wound formation under the impact of sharp and blunt-edged injuring objects.

Reliable morphological criteria were identified, allowing:

- differentiation between injuries caused by sharp and blunted blades;
- determination of structural features of the injuring object;
- assessment of the mechanism and conditions of traumatic impact;
- improvement of the objectivity of forensic medical examinations.

The obtained data are of important practical significance for forensic medical experts in identifying injuring instruments and reconstructing the circumstances of injury infliction.

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