MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
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GENERAL QUESTIONS OF FORENSIC TRAUMATOLOGY. DAMAGE BY BLUNT SOLID OBJECTS. DAMAGE BY SHARP OBJECTS.

Educational-methodical recommendation
for 5th year students of medical and physical science faculties
in the discipline "Forensic medicine"

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GENERAL QUESTIONS OF FORENSIC TRAUMATOLOGY. DAMAGE BY BLUNT SOLID OBJECTS. DAMAGE BY SHARP OBJECTS.
(total lesson time - 6 academic hours).

RELEVANCE OF THE TOPIC

The identification of a traumatic object by damage is an important task of forensic medicine. However, as a rule, it is always possible to determine its group affiliation. In some cases, the features of the shape, surface (bottom), as well as the size of the damage to one degree or another reflect the details of the traumatic object, which makes it possible for the doctor to make a judgment about the shape and size of the traumatic surface of the trauma instrument. When determining the weapon of injury by the characteristics of damage, it should be remembered that the same object can cause various types of damage (abrasions, bruises, wounds) or damage that are different in shape and size.

THE OBJECTIVES OF THE LESSON

To study general issues of traumatology (definitions of concepts, classification, mechanism and conditions for the occurrence of injuries, types of traumatic effects, etc.). The mechanism of damage formation when exposed to solid blunt objects. The mechanism and features of damage to soft integuments, depending on the properties of the traumatic surface of the object and the conditions of its impact; diagnostic and differential diagnostic signs of damage to the soft integument. The mechanism and features of bone damage, depending on the properties of the traumatic surface of the object and the conditions of its impact; the concept of "local" and "structural" fractures. The mechanism and features of damage to internal organs. Features of sectional technique in the examination of corpses in cases of falling from a height and examination of the corpse at the scene.

TASKS

1. Be able to describe the damage to the soft integument, internal organs, bones.
2. Based on the identified morphological signs of damage, carry out diagnostics and differential diagnostics of various types and varieties of damage.
3. Assess damage - to determine the lifetime and prescription, mechanism and conditions of occurrence, causal relationship with the onset of death. Make additional sectional incisions for examining soft tissues, bones, joints.
4. Identify and describe damage to soft tissues, bones, internal organs. Assess the detected damage: install the mechanism of formation, the possibility of occurrence with one or another type of injury, to carry out differential diagnosis of various types of injury.
5. Draw up a forensic diagnosis and conclusions (conclusion) during examinations.

KEY LEARNING QUESTIONS

1. Definition, concept, classification of bodily injury.
2. Causes of injury and its types.

3. Mechanical damage and their morphological characteristics.
4. Types of blunt wounds.
5. Causes of death due to mechanical damage, their morphological manifestations.
6. Determination of the intravital and posthumous origin of the injury.
7. Technique for describing bodily injury.
8. Possibilities of determining the type of blunt object and the mechanism of its action by the characteristics of injuries on the body and clothing of the injured person.
9. Damage when falling on a plane and from different heights; falling on a flight of stairs.
10. Definition of the concept and classification of sharps.
11. The mechanism of action of sharp objects on the human body, types of injuries and their morphological features.
12. Differential diagnosis of wounds from injuries with sharp objects.
13. Possibilities of establishing the types of sharp objects and mechanisms of their action according to the characteristics of injuries on the body and clothing of the injured person.

MATERIALS FOR CONTROL OF THE TOPIC ASSEMBLY

Terminology

Tool - a tool (object) used for a specific purpose in everyday life or in production.

A piercing tool is any object that is dense enough to penetrate the damaged tissue and is characterized, as a rule, by a predominant length, a different cross-sectional shape, the presence of a sharp end and the absence of a sharp edge.

A piercing-cutting tool is any object that is dense enough to penetrate the damaged tissue and structurally combines two traumatic elements: a sharp stabbing end and a sharp cutting edge.

A cutting tool is any object, a mandatory structural element of which is a sharp cutting edge (one or more).

Chopping tool - an object with a sharp edge, significant mass, wedge-shaped section and causing damage by the mechanism of impact.

A wound is a violation of the integrity of the skin or mucous membranes throughout their entire thickness, caused by mechanical stress.

Stab wound - a wound inflicted with a sharp object with a small cross-sectional size and characterized by a narrow and long wound channel.

A cut wound is a wound inflicted by a sliding motion of a thin sharp object.

Chopped wound - a wound from a blow with a heavy sharp object.

Injury is a mechanical effect on tissues and organs, entailing a violation of their integrity with the formation of a wound.

Multiple injury - injury to two or more organs or areas of the body by several damaging agents.

Non-penetrating wound is a wound in which the formed wound channel does not communicate with any cavity of the body.

Blind wound - a wound in which the resulting wound channel does not have an exit hole.

Combined injury - injury by a single damaging agent of two or more organs or areas of the body.

A wound channel is a set of injuries formed along the trajectory of a wounding weapon.

Wound cavity - the space bounded by the walls and bottom of the wound.

GENERAL QUESTIONS OF FORENSIC TRAUMATOLOGY.

Mechanical damage includes damage arising from the action of mechanical damaging factors. This group includes injuries caused by objects that provide blunt and sharp impacts, injuries from falling from a height and on a plane, some types of gunshot and explosive injuries, various types of mechanical asphyxiation.

The damaging factors of a shot and an explosion formally have a combined damaging effect (mechanical, thermal, chemical). However, the predominant mechanical action gives grounds to conditionally include gunshot and explosive injuries in the section of mechanical damage.

Most mechanical injuries are characterized by pronounced changes in the anatomical structure of tissues and organs. These are abrasions, bruises, wounds, fractures, dislocations, hemorrhages under the membranes and into the tissue of internal organs, ruptures, crushing and crushing of these organs, partial and complete separation of body parts, partial and complete destruction of the body.

Mechanical damaging factors are bodies that have a shape fixed in space at the time of their impact. This property can be permanent (butt of an ax, stone, etc.) or temporary (powerful jet of water or compressed air). These significantly different factors can cause very similar damage. Less commonly, functional changes prevail over anatomical ones: painful shock, cardiac arrest due to trauma to reflexogenic zones, functional consequences of concussion of internal organs. The first group of injuries is called predominantly anatomical, the second predominantly functional. The term "predominantly" emphasizes that just as there can be no disturbances in the structure of a living organism without disturbing its function, the disturbance of function cannot occur without disturbing anatomical structures.

Mechanical damage is distinguished by a large morphological and functional variety. They can be single and multiple, isolated and combined. In this case, tissues and organs can be damaged in a wide variety of ways. Therefore, it is very important to present a general systematization of mechanical trauma and its relationship with particular classifications of injuries to parts of the body, organs and tissues.

In the proposed classification, a single injury is understood as the presence of a single individual injury in the victim: abrasion of the face, bruising of the thigh, gunshot wound to the chest, etc. As a rule, such injuries occur as a result of a single traumatic effect.

Multiple trauma is a combination of two or more single injuries: multiple gunshot injuries to the trunk, multiple chopped wounds to the head, etc. Multiple trauma arises from multiple traumatic effects.

Isolated injuries include injuries within one part of the body: the head, neck, chest, abdomen, pelvis, spine, upper and lower extremities. Isolated trauma can be single (gunshot wound to the thigh, chopped neck wound, etc.) and multiple (multiple stab and cut wounds of the abdomen, etc.). Private classifications of isolated injuries include systematization of damage to individual areas of the body: head, chest, pelvis, etc.

A concomitant injury is an injury to several parts of the body. Most often, concomitant injury is multiple. However, there is also a single combined injury: a combined bullet wound of the chest and abdomen with a single wound channel; separation of the chest, abdomen, pelvis and spine by the hydrofoil of a river or sea vessel; sawed wound of the head, neck and chest from the action of a circular saw, etc. Private classifications systematize the combined injury by

its volume (depending on the number of damaged parts of the body) and by localization (for example, combined injury of the head and chest, head and abdomen, head and limbs, etc.).

The concept of concomitant injury is to a certain extent conditional. In relation to the body as a whole, concomitant injury is understood as damage to several parts of the body. At the same time, in relation to a separate part of the body (for example, the head), one can speak, for example, of a concomitant injury to the organs of sight and hearing.

Both isolated and combined injuries are a set of injuries to various organs and tissues, the morphological characteristics of which determine a specific variant of mechanical injury. Private classifications of injuries to organs and tissues systematize trauma to the skin and subcutaneous tissue, bones, hollow and parenchiatous internal organs, blood vessels, nerves, etc. Damage to the skin and subcutaneous tissue, depending on the type of injury, is divided into injuries with blunt and sharp objects, gunshot injury, etc. etc. Blunt object injuries, in turn, are divided into abrasions, bruises, wounds, etc. Wounds are subdivided into bruised, lacerated, torn-bruised or bruised-lacerated. The same principles underlie the systematization of damage to other tissues and organs.

DAMAGE BY BLUNT SOLID OBJECTS.

Objects that cause damage by acting mechanically only with their surface are referred to as blunt. Blunt objects can be hard or soft. Direct violation of the anatomical structure of tissues occurs, as a rule, when exposed to solid blunt objects. A blunt effect can be exerted by a high-pressure jet of liquid or gas. However, such observations are classified as casuistic. Therefore, in what follows, the term blunt object will mean solid blunt objects. Blunt effect is said in cases where mechanical damage is caused by the surface of an object.

The shape and size, weight, strength and elasticity, the nature of the surface of blunt objects are very diverse. Their kinetic energy at the moment of impact, the place and direction of the acting force are different. All this determines a significant morphological variety of injuries caused by blunt objects. The properties of injuries to a certain extent depend on the anatomical and physiological properties of the affected part of the body, the presence of concomitant pathology and injuries, the age of the victim, the duration of the injury, the nature of healing, etc.

The nature of damage at the place of application of force is mainly determined by the properties of the traumatic surface of a blunt object. Its main characteristics - size, shape and relief - form the basis for the classification of blunt objects.

In terms of size, there are limited and unlimited (wide) traumatic surfaces. A limited surface is such a surface, the boundaries of which (all or some of them) do not go beyond the surface of the damaged part of the body. This concept has a relative character, since the same surface of the same object, depending on the size and shape of the surface of the damaged part of the body, in some cases will be limited, in others - unlimited (wide). If the dimensions of the traumatic surface of a blunt object go beyond the impact area, then such a surface is considered as unlimited. So, when hitting the back of the head with the plane of a wide board, the traumatic surface will be unlimited in relation to the surface of the damaged area of the head. If the same plane of the same board is hit on the back, then the traumatic surface will be limited in relation to the area of the back. In case of impacts with an object with a limited traumatic surface, the shape and dimensions of the damage are determined, first of all, by the size and shape of the

traumatic surface. When exposed to an object with an unlimited surface, the shape and size of the damage will mainly be determined by the properties of the damaged part of the body.
If it is established that damage has arisen from the action of an object with a limited impacting surface, it is imperative to speak about both the specific shape and the specific dimensions of the injuring surface of this object.

The shape of the traumatic surface can be flat (triangular, square, rectangular, oval, round, etc.), angular (in the form of a dihedral angle - ribbed or in the form of a polyhedral angle or apex), a curve (spherical, cylindrical, etc.) and combined (a combination of flat and curved surfaces, a combination of flat and angular surfaces, other combinations). Angular objects have edges, edges, and vertices. A face is a flat surface bounded on all sides. An edge is the convergence line of two faces. Vertex - the area of convergence of three or more edges and faces.

The relief of traumatic surfaces and ribs can be even (smooth) and uneven (uneven, rough, with small protrusions and sinks).

There are four main options for blunt exposure: impact, compression, stretching, friction.

Impact is a complex short-term process of interaction between the body (or part of the body) of a person and a blunt object, in which the latter has an impulsive unilateral centripetal effect on the body or part of the body. The impact can last less than 0.1–0.01 seconds.

The shorter the impact time, the more energy is transferred to the affected part of the body and the greater the amount of damage. However, with an ultra-short impact time, a paradoxical effect occurs: the volume of damage becomes smaller, since only a small part of the energy of the damaging object is transferred to the damaged part of the body. The latter option in forensic practice occurs in exceptional cases. The impact is exerted both by a moving object (for example, a thrown stone, protruding parts of a moving car, etc.) and a stationary one (for example, a blow to the head when falling to the ground); massive objects that act with great force can shake the body or part of the human body.

Compression is the process of interaction of the body or part of the human body with two, usually massive, solid blunt objects, in which both of these objects, acting towards each other, exert a bilateral centripetal action on the body or part of the body. Compression time is calculated in seconds, and in some cases - minutes. Of the two crushing objects, one is always mobile, the other is most often motionless, for example, pressing a person with a car body to stationary objects (a wall of a house, a fence, etc.).

Stretching is the process of interaction of the body or part of the human body with two solid objects, which, acting in diverging directions, exert a bilateral centrifugal action on the body or part of the body. The stretching time is tenths of a second, less often a few seconds. Of the two objects, one is always mobile, the other is usually motionless. A stationary object fixes the body or part of the body (for example, the body of the machine tool), while another object has an eccentric effect (rotating parts of the machine tool). An eccentric effect is exerted by a fragment of flat or tubular bone that damages the skin. The impact in this case is complex and is a combination of stretching, stabbing, and sometimes cutting actions. However, the main course of action here is also stretching.

Friction is a process of surface interaction of a damaged body surface and a damaging surface of a blunt solid object, in which both contacting surfaces are displaced in a tangential or tangential direction relative to one another. The damaged part of the body, and the damaging object, or both, can be mobile.

All types of mechanical damage are formed from the action of blunt objects: abrasions, bruises, wounds, fractures, etc. The morphological features of these injuries make it possible to determine:

- signs (properties) of a traumatic blunt object;
- the mechanism of damage formation.

The essence (type) of damage is determined by the variant of the traumatic blunt effect. Typical for impact action will be bruised wounds, fractures, for compression - flattening of a part of the body, stretching of organs and tissues, for stretching - torn brines, skin detachment, for friction - extensive sedimentation. At the same time, some types of damage can result from different types of exposure. So, bruising occurs both from impact and from compression, abrasions - from impact and from friction, ruptures of internal organs - from impact, compression and stretching.

An abrasion is a superficial damage to the skin that does not extend deeper than its papillary layer. The bottom of the abrasion is initially moist, shiny, located below the level of the surrounding skin. After a few hours, the bottom dries up and gradually begins to fill with a crust, which is a necrotic epithelium and the papillary layer of the dermis. By the end of the first day, the crust reaches the level of the surrounding skin, then rises above it. From the 4th - 5th day along the borders of the abrasion, epithelialization begins, and the edges of the crust rise. By the 7th-9th day, epithelialization ends, and the crust falls off, exposing a pink surface that easily collects into small folds. By the end of the 2nd week, the place where the abrasion was, does not differ from the surrounding skin. Abrasions caused by blunt objects can be located on any part of the body surface. The number of abrasions, as a rule, equals the number of traumatic actions. However, abrasions localized on protruding parts within one area of the body or on several mating surfaces of the body can also form from a single action of a wide surface of a blunt object. The sizes of abrasions range from point to several tens, and sometimes hundreds of square centimeters. The area of abrasions depends on the area of the blunt object's surface in contact with the body and on the length of the dynamic contact. With such contact, a blunt object forms an abrasion, the initial section of which is most deep. At the opposite end, whitish patches of exfoliated epidermis may be visible. These morphological signs make it possible to establish the direction of movement of a blunt object with the formation of abrasions (or the direction of movement of the body, but in relation to a motionless blunt object).

The form of abrasions is diverse and depends on the shape of the traumatic surface of a blunt object and the mechanism of abrasion formation. With dynamic contact, a strip-like abrasion is formed, the width of which can reflect one of the dimensions of the traumatic surface of a blunt object. Sometimes on the surface of the abrasion, multiple parallel rectilinear surface scratches are distinguished, which arise because the traumatic surface of the object was uneven, rough. When struck or squeezed, the shape of the abrasion often repeats the shape and relief of the surface of a blunt object. On the surface of the abrasion, elements of the material of the traumatic object, or extraneous layers, or contamination present on the surface of a blunt object can be deposited. Abrasion allows you to determine:

1. the fact of injury and the blunt nature of the impact;
2. the duration of the injury;
3. the shape, relief, size of the traumatic surface and the material of the blunt object, extraneous layers on its surface;
4. the direction of movement of the injuring object or body, if the injuring object is motionless;

5. place of application of force;
6. variant and number of traumatic influences.

A bruise is a hemorrhage that permeates the subcutaneous fat. Initially, the bruise has a blue or blue-purple color, which is determined by the fact that the dye of the blood is in a state of reduced hemoglobin. From the 3rd - 4th day, the bruise becomes greenish (due to bilirubin and verdochromogen), and from the 7th - 9th day - yellowish (due to bilirubin) shades. After this period, the bruising, as a rule, becomes imperceptible. However, when the skin is cut for a long time in the subcutaneous fatty tissue, one can see a brownish hemorrhage (due to hemosiderin). If hemorrhages are formed only in the skin, they speak of intradermal hemorrhages. They are usually multiple, small and round. The accumulation of blood above (or below) the lining of the brain in the subcutaneous tissue is called a hematoma.

Bruising is typical of the action of a blunt solid object and can have a wide variety of localizations. The shape and size of the bruises depend on the shape and size of the traumatic surface of the blunt object. Almost always, one bruise is formed from one blow with a blunt object. However, with a strong impact with an elongated object, two elongated bruises may occur, located on either side of the impacting surface of such an object. The explanation for this phenomenon is that blood vessels are more resistant to compression than to rupture. Therefore, in the stripe of impact, the vessels are compressed and retain their integrity, and at the border of this stripe, they stretch and break.

Bruising reflects:
1. the fact of injury and the blunt nature of the impact;
2. the duration of the injury;
3. the shape, size and relief of the traumatic surface of a blunt solid object;
4. variant and number of traumatic influences;
5. place of application of force.

A wound is a lesion that extends deeper than the papillary layer of the skin. Wounds resulting from the action of blunt solid objects are divided into bruised, lacerated and bruised-lacerated (with deep injuries, clinicians sometimes talk about muscle or bone wounds, brain wounds, etc.).

Bruised wounds arise from a blow, lacerated - from stretching, bruised-lacerated - from a combination of both mechanisms (most often such wounds arise from a blow with a blunt object acting at an angle).

Common signs of a bruised wound: uneven, sagging, bruising, often crushed edges of the wound. In its depths there are whitish connective-woven lintels.
The lacerated wound, with the exception of the roughness of the edges, does not have the listed signs.

The expert value of a lacerated wound is, as a rule, exhausted by the definition of the type of traumatic effect (stretching). A bruised wound has incomparably greater forensic medical information content.

Although bruised wounds can form anywhere on the surface of the body, they are most often found where the bone is closest to the surface of the skin, for example on the head. At the edges of the wound, elements of the material of the traumatic object or traces of foreign layers on its surface can be found.

Objects with an unlimited traumatic surface form bruised wounds surrounded by a wide continuous sediment. The peculiarity of precipitation is that it is most pronounced in the central

sections, and loses its intensity towards the periphery. Its edges are uneven and blend smoothly into intact skin. The wound can have various forms (rectilinear, three-beam, etc.), which are determined by the structure of the underlying bone. In the center of the wound, there is an area of the greatest crushing of soft tissues, from which several tears with relatively sharp ends move to the sides. The bottom of the gap is represented by wide connective tissue bridges, in the center of the bottom there are crushed soft tissues. Intact hair often hangs over the bottom of the wound.

The nature of bruised wounds arising from the action of a limited surface of a blunt object largely depends on its shape and size. The overall dimensions of such wounds do not go beyond the traumatic surface of the object. The rib of a blunt object causes brines straight, square and rectangular traumatic surfaces form 7 "- or 77-shaped wounds, triangular - angular, round and oval - C-shaped. The edges of such wounds usually have a narrow deposition. The bottom of the wounds is deepened, connective- the woven bridges are narrow, represented by individual fibers and are observed mainly in the area of the corners of the wounds.

The walls of wounds arising from a perpendicular impact are sheer. When struck at an angle, one of the walls of the wound is beveled, the other is undermined.

Blunt objects acting with a spherical or cylindrical surface cause rectilinear wounds with additional tearing of the edges. They are surrounded by a relatively widespread siege. The edges of such wounds are often crushed.

Blunt wounds indicate:

1. on the variant of traumatic impact (impact, compression, stretching, friction);
2. the prescription of the injury;
3. the blunt nature of the impact;
4. on the number of traumatic effects;
5. on the shape, size of the traumatic surface and material of a blunt object, the nature of extraneous layers on its surface;
6. to the place, direction and strength of the traumatic effect.

A fracture is an injury to a bone or cartilage. There are fractures arising from direct contact traumatic action (direct fractures) and from indirect action (indirect fractures, fractures along the length). Direct fractures make it possible to judge the properties of the traumatic object, the type and variant of the traumatic effect, indirect fractures - only about the variant of the traumatic blunt effect.

Direct fractures are distinguished by the fact that destruction, crushing and mutual layering of bone structures occur at the point of contact of the traumatic object with the bone. As a result, small defects are observed at the place of application of the force due to crumbling of the bone substance. At the edges of the defect, raised flat bony plates are visible, often layering on top of each other and giving the impression of a tiled roof. Indirect fractures are devoid of these features. The edges of straight fractures are a coarsely serrated broken line, those of indirect fractures are finely serrated. These signs make it possible to differentiate between direct and indirect fractures of any bones of the skeleton.

Fractures of tubular bones can occur from shear, bending, compression, twisting, and tearing.

The displacement of the bone occurs from a sharp impact by an edge, edge or narrow limited surface of a blunt object. Shear fractures are always straight. They have the character of transverse or oblique transverse. A small cleavage of the compact substance is formed at the

place of application of the force. Thin cracks extend from the edges of the fracture, the free ends of which indicate the place of impact. Sometimes the ends of the cracks extending from the opposite edges of the fracture join and form a large fragment, most often of a diamond-shaped form, at the impact site.

Bone bending leads to a change in mechanical stresses in the bones: a stretch zone appears on the convex surface of the bend, and compression on the curved surface. Since the bone is less resistant to stretching, a transverse crack forms on the convex surface of the shaft, which extends to the lateral surfaces, where it bifurcates. The ends of the crack join on the compression side to form a large splinter. Flexion of the tubular bone can occur with transverse pressure on the diaphysis (for example, when moving with a car wheel), with longitudinal pressure on the bone, as well as when flexing the bone, one of the epiphyses of which is fixed.

Compression of the bone in the longitudinal direction underlies the formation of impacted fractures. They are localized in the metadiaphyseal region and represent a local compression destruction of the beam structure, which is often combined with fractures that split the diaphysis in the longitudinal direction. Such fractures occur when falling from a great height on straightened legs.

Twisting of the bone is its rotation around the longitudinal axis while simultaneously fixing one of its (bone) ends. In this case, helical fractures occur (often observed in skiers).

The separation of bone substance is possible only in the area of attachment of the tendons. The separated part of the bone mass is usually small. As a rule, such fractures are observed with sharp tensions of the tendons in young subjects with incomplete ossification processes.

Fractures of flat bones depend on the size and shape of the traumatic surface of a blunt solid object and the option of its action: impact or compression. From a blow to the place of application of force, unilateral direct fractures occur.

Objects with a limited impact surface, acting with little force, can cause a linear fracture (crack) that expands in the direction of impact. Several radially diverging fractures can also form at the site of the force application. From some of them, additional cracks may extend, which, connecting and mutually intersecting, can form comminuted fractures in a limited area of the cranial vault. Under stronger influences, depressed fractures are formed that correspond to the size of the traumatic surface and are often a negative reflection of its shape. At the edges of such fractures, stepped fragments can form, which gives reason to call these fractures terraced. Impacts of great force can cause a complete shear of a portion of the bone with the formation of a perforated fracture, reflecting the shape and size of the traumatic surface of the object.

A low force impact caused by an unrestricted surface of a blunt solid object may result in one or two to three radially diverging cracks. With impacts of great force, a focus of comminuted fractures is formed at the site of its application, bounded by an arcuate crack. Linear cracks radiate from this center. The stronger the blow, the larger the area of the focus of comminuted fractures. In the area of the focus of comminuted fractures, deformation in the form of a flattening of the skull is noticeable.

When compressed, forces are applied to mutually opposite surfaces of the head and are directed towards each other. In places where the force is applied, foci of finely splintered fractures are formed, surrounded by one or more concentric, one after the other, arcuate cracks. Foci of comminuted fractures are united by rectilinear or slightly curved cracks showing the direction of compression. Compression is often accompanied by deformation of the head, up to

its complete flattening. In rare cases, when compressed, a single linear crack is formed. It arises from stretching (cracking) of the bone outside the places of application of force and is an indirect fracture.

With several blows to the head, the fracture line resulting from the subsequent blow will be interrupted by the fracture lines resulting from the previous blows.

When striking the chest at the site of the strikes, there are straight, transverse or comminuted fractures of the ribs or sternum, accompanied by ruptures of the parietal pleura. When compressed, multiple bilateral double and triple rib fractures are formed: direct fractures occur at the places of application of force, and indirect fractures occur at a distance from the place of application of force.

Fractures of the spine from a local impact lead to comminuted fractures of the bodies and processes of individual vertebrae. Under the action of forces along the axis of the spine, compression fractures of the vertebral bodies are formed. With excessively sharp flexion of the spine, dislocations and wedge-shaped compression of the anterior parts of the cervical vertebral bodies most often occur (with extension, the posterior parts). Such fractures are usually accompanied by damage to the ligamentous apparatus of the spine. These fractures are not uncommon in traffic accidents, and the mechanism of their occurrence is called whiplash.

When hitting the pelvic area at the place of force application, one-sided straight single, or double transverse, or comminuted fractures occur. When the pelvis is compressed, bilateral double vertical fractures are formed: in the places of application of force, direct fractures are found, and at a distance - indirect fractures of the pelvic bones. Microstructural changes in the fracture zone also make it possible to differentiate the mechanism of violation of the integrity of the bone tissue.

Fractures allow you to establish:

1. blunt nature of the impact;
2. fact, type, place, direction, strength and variant of traumatic impact;
3. the duration of the injury;
4. number and sequence of blows;
5. the shape and size of the traumatic surface of a blunt object.

Internal organ damage. The morphological features of the internal organs make it possible to judge very limitedly about the mechanism of action of a blunt solid object and, to an even lesser extent, about its properties. Such injuries are rarely isolated, therefore, the mechanism of action and properties of a traumatic object is judged on the basis of an assessment of the morphological signs of the entire set of injuries to soft tissues, bones and internal organs.

When objects of small mass act on the head, they can cause injury only at the place of application of force, where a single injury is observed, including: a bruised wound (less often - an abrasion or bruise), depressed, terraced, comminuted or comminuted-depressed fractures, ruptures of the dura mater and damage by the edges of the broken bones of the brain tissue and pia mater.

Almost any type of intracranial injury and hemorrhage can occur with a head injury. Of these, the most specific are focal bruises of the cerebral cortex.

One of the morphological variants of bruising of the cortex is the destruction of the cerebral cortex and the pia mater, bordered from the surface by a wide strip of subarachnoid hemorrhages, and in the depth by multiple and small focal hemorrhages with a diameter of less than 1 mm. Such foci are usually limited to the thickness of the bark and rarely

capture the nearest subcortical zone. Another option is distinguished by the preservation of the integrity of the pia mater and the anatomical pattern of the cortex. In this case, the focus of bruised cortex on the surface of the brain is a group of spotty subarachnoid hemorrhages of round and oval shape with an area of no more than 1 cm2. In the center of the focus, they can merge with each other, forming a hemorrhage with uneven scalloped edges, surrounded by separate small hemorrhages. In the section of this area, multiple punctate, small-focal or narrow and short strip-like hemorrhages are visible, located mainly in the cortex and in small adjacent areas of the subcortical zone. Foci of contusion capture 1 - 2 convolutions, less often - the surface and pole of one or two lobes of the brain. The area of the bark bruises is directly proportional to the magnitude of the traumatic force.

The location of bark bruises relative to the place of application of force is remarkable. When struck from behind, for example, when falling backwards, they are found at the base and poles of the frontal and temporal lobes. When hitting the head from the front, they are usually localized in the same place, and only when hitting an extremely strong force can they form on the convex surface and poles of the occipital lobes; lateral blows to the head in 2/3 of cases lead to the formation of shock-resistant foci of bruising of the cortex on the convex surface of the opposite temporal lobe, in 1/3 - bruises of the cortex occur in the temporal lobe at the place of application of force. In cases where the place of application of force is the parietal region, foci of bruising of the cortex are found on the basal surface of the frontal and temporal lobes. In these places, bruises of the cortex are found under the action of force from below, for example, when falling from a great height on straightened legs and buttocks. Comparison of the place of application of force and the localization of the focus of the bark injury in the area of the counter-impact allows one to establish the direction of the impact.

Focal cortical bruises occur during acceleration trauma, when the head comes into contact with an object that significantly exceeds its mass. As a result of such contact, the movement of the head is accelerated or slowed abruptly. Most often, this mechanism of injury occurs in traffic injuries and falls from a height. When the head is compressed, focal cortical bruises do not occur. The membranes and tissue of the brain can only be injured by fragments of bones. The amount of hemorrhage will depend on the diameter of the vessel.

Spinal cord injury occurs only in places where the integrity of the spinal column is disturbed in the form of compression fractures and dislocations of the vertebral bodies, ruptures of the ligamentous apparatus and joint capsules. Brain damage can range from local intrathecal hemorrhage to complete interruption. The properties of the traumatic object and the mechanism of its action can be judged mainly by the nature of the damage to the bone and ligamentous-articular structures of the spinal column.

Damage to the internal parenchymal organs (liver, kidneys, spleen, etc.) is quite diverse: hemorrhages under their visceral membrane, under the capsule and into the organ tissue, ruptures of the outer membrane, ligamentous apparatus and organ tissue, partial crushing, complete destruction and detachment of the organ.

Small superficially located hemorrhages, isolated superficial tears of tissue are more often formed with strong impacts with objects with a limited traumatic surface. Multiple ruptures of the membranes and tissue of the parenchymal organ, combined with extensive hemorrhages in its tissue, can be the result of both a strong blow with a massive object and compression. Partial crushing or complete destruction most often occurs when a part of the body is compressed by a massive object, for example, when moving by a wheel of a car or railway transport.

Damage to hollow internal organs (stomach, intestines, gall or urinary bladder, etc.) is no less diverse: complete or partial ruptures of the organ wall, intrathecal hemorrhages, damage to the ligamentous apparatus and complete separation of the organ. Ruptures of a hollow organ and local hemorrhages in its wall arise from a strong shock or squeezing action.

Separation of the internal parenchymal and hollow organs from the places of their attachment, as well as a violation of the integrity of the fixing apparatus of these organs, are observed under strong shock effects with massive blunt objects, leading to a general concussion of the body. At the moment of injury, an abrupt displacement of the organ occurs, leading to a partial or complete rupture of one or more fixing structures (ligaments, arteries, veins, etc.), and in case of extremely high force impacts, a complete separation of the organ.

The morphological signs of a general shock concussion of the body include: hemorrhages in the root zone of the lungs, peri-aortic tissue, the ligamentous apparatus of the liver and stomach, the mesentery of the small intestine, the gates of the kidneys and spleen, ruptures of the hepatic ligaments, stomach ligaments, mesentery of the small intestines, vascular pedicles of the spleen and ureters vessels of the kidneys. The stronger the impact, the greater the volume and severity of morphological signs of general body concussion.

The morphological features of injuries to internal organs make it possible to establish the fact of injury, type (injury of acceleration, compression, etc.), place, direction, number, strength and duration of the traumatic effect.

In forensic medical practice, injuries are often found caused by nails, fingers, fist, palm edge, leg, teeth, less often - head, knee, elbow.

With static action, the free edges of the nails form arcuate, with dynamic action - strip-like abrasions.

Finger pressure results in several small, round or oval bruises, sometimes associated with arcuate or short stripe-like abrasions (from nails) located on their background.

Punching or kicking can lead to injuries of various sizes and nature: from superficial abrasions and bruises to bone fractures and ruptures of internal organs. Similar injuries can be caused by the head, elbow, knee. The volume, nature and localization of these injuries largely depend on whether the attacker possessed the techniques and skills of special types of wrestling (karate, jiu-jitsu, etc.). However, these injuries in no way reflect the properties of the surface relief of the traumatic object.

An impact with the edge of the palm can cause significant injury in a confined area. Such blows to the neck can cause dislocations, fractures-dislocations or fractures of the cervical vertebrae, sometimes in combination with a violation of the integrity of the spinal cord.

Several abrasions, bruising, or superficial wounds are formed with the bites. These lesions are located in the form of two arcuate stripes facing bulges in opposite directions.

A steeper arc of damage usually arises from the action of the teeth of the lower jaw, a shallower one - of the upper one. In damage from a bite, the features of the dental apparatus can also be displayed: anomaly of bite, gaps in the place of missing teeth, atypical structure of one or more teeth, unusual position of the tooth, etc.

FALL DAMAGE

A damaging object is an object on the surface of which a body falls. The height of the fall varies over a wide range: from the height of a person to several dozen (falls from windows and from the roofs of buildings, industrial structures, mountain rocks, etc.) and hundreds of meters

(in the latter case, we are most often talking about falls from aircraft, in including with an unopened parachute).

With a direct (unhindered) fall, the main damage to the human body occurs from a single shock impact. The nature of these damages is determined by the size and relief of the fall surface. In most cases, this surface is unlimited in size. Falls on freestanding large-sized objects are much less common, the area of impact of which is limited to surfaces adjacent to the edges or corners of this object. The relief of the traumatic surface can be relatively flat (asphalt pavement, concrete slabs, etc.) or uneven due to potholes or on the surface of small objects (individual stones, gravel, crushed stone, etc.). The surface can be hard (asphalt, concrete) or relatively soft (sand, soil, turf, etc.).

In an indirect (stepped) fall, the body encounters during its movement any protruding objects with a limited traumatic surface (balconies, canopies, awnings, cornices, electrical wires, ropes, etc.). The shape, size and relief of the traumatic elements of these objects are quite diverse.

Falls in a confined space (for example, mines, staircases), as well as falls on uneven inclined surfaces: escalator steps, steep mountain slopes, etc., are usually characterized by a stepped nature.

Often, when any structures or their individual structures collapse, various objects fall along with the human body (the so-called non-free fall), which can cause damage to it both during movement and after the body falls to the ground. The shape, size, relief and hardness of these objects are also very diverse.

A fall from a height is characterized by the occurrence of multiple injuries, which are usually formed on various parts of the body.

With a direct free fall, injuries are formed, which have the following typical set of signs (regardless of the place where the force is applied):

- little or no external damage;
- one-sided localization of damage;
- the presence of fractures far from the place of application of force (the so-called fractures along the length, or distant fractures: impacted fractures of the long bones of the lower extremities, compression fractures of the vertebral bodies, annular fractures of the base of the skull, etc.);
- the prevalence of the volume of damage to internal organs over the volume of external ones;
- the presence of signs of a general concussion of the body (hemorrhage in the para-aortic tissue, the root zone of the lungs, the ligamentous apparatus of the liver, the gates of the kidneys and spleen, the mesentery of the small intestine, etc.).

With strong impacts on the ground, ruptures of hollow and parenchymal organs can form. The higher the height of the fall, the more pronounced the signs of a general concussion of the body. With a direct free fall on different parts and surfaces of the body, the following injuries are formed: on the head - multi-splintered fractures of the cranial vault, on the buttocks - comminuted fractures of the ischial bones, on the legs - destruction of the calcaneus, on the lateral surface of the body - direct fractures of the ribs on the side of the fall and indirect - on the opposite side, on the back - comminuted fractures of the scapula, spinous processes of the vertebrae and multiple direct fractures of the ribs along the paravertebral and scapular lines, on the anterior surface of the body - oblique or comminuted fractures of the sternum, multiple

bilateral fractures of the ribs along the parasternal or midclavicular line, damage facial skeleton, fractures of the knee caps, impacted fractures of the distal metaphyses of the radius.

Fractures that form far from the place of application of force are also characteristic of direct free fall from a height: compression fractures of the vertebral bodies and the body of the sternum occur when falling on the buttocks, the plantar surface of the feet of the straightened legs and head, hammered fractures in the metaphyses of the femur and tibia - when falling on the heels; ring-shaped fractures of the base of the skull - when falling on the buttocks and plantar surface of the feet of the straightened legs.

The place of application of force upon impact on the ground is related to the trajectory of the fall and depends on the height of the fall, the initial posture of the victim, as well as on whether the body was given preliminary acceleration (self-repulsion from the support, external push above or below the center of gravity of the body, etc.).). Depending on the state of the person (for example, alcohol intoxication, unconsciousness), the fall may be uncoordinated. The aggregates of damage in coordinated and random falls are different.

Injuries resulting from stepped and non-free falls have some distinctive features. While all other signs of damage from falling from a height (multiplicity, distant fractures, prevalence of the volume of internal injuries and signs of general body concussion) are preserved, they are characterized by versatile localization and can be located not only on adjacent, but also on opposite surfaces of the body.

If, in a direct free fall, injuries, despite their multiplicity, are formed from a blunt, predominantly shock impact, then with a step-like and non-free fall, along with injuries from blunt impact, lacerated, stabbed, cut and stab-cut wounds may occur.

To establish the mechanism of the fall in a particular case, they resort to the help of an investigative or expert experiment. For this, an anatomically balanced dummy is used, which simulates the body of the victim. The dummy is dropped under various static and dynamic reference conditions. The trajectory of the fall is recorded using video or high-speed filming, and the final position of the body is recorded on large-scale diagrams.

The judgment about the specific variant of the fall is based on the entire set of available objective data: the morphology of injuries, the position of the body after the fall, the situation at the scene of the accident, and the results of the experiment.

When a person falls from a height of his own growth, they speak of falling on a plane. In this case, the head suffers mainly. Abrasions, bruises, bruised wounds, fractures of the facial or cerebral volumes of the skull usually occur at the site of application of force. The fracture lines correspond to the direction of the fall.

When falling on the forehead or the back of the head, focal bruises of the cerebral cortex are formed at the base and poles of the frontal and temporal lobes: red softening, surrounded by multiple punctate and small-focal hemorrhages, mainly involving the area of the cortex and the nearest subcortical zone. When falling on the temporal region, focal cortical bruises are more often localized on the lateral surface of the opposite temporal lobe and less often in the temporal lobe cortex at the place of application of force.

A fall on the posterolateral surface of the head (left or right half of the occipital region) most often leads to the formation of focal bruises of the cortex at the base and poles of the frontal and temporal lobes of the opposite cerebral hemisphere. When falling with a preliminary push to the chest, abdomen or blows to the head, external injuries are usually formed in the area

close to the upper parts of the head (parietal region). Intraventricular and subdural hematomas can occur with any mechanism of fall.

DAMAGE BY CUTTING OBJECTS
DEFINITION AND MECHANISM OF ACTION

A cutting tool is any object, a mandatory structural element of which is a sharp cutting edge (one or more). Nevertheless, the concept of "cutting" is determined not only by the design features of the tool, but also by the mechanism of its action. From this point of view, the same object, depending on the conditions of action on the damaged surface, can simultaneously have a cutting, piercing-cutting and chopping effect (kitchen knife, dagger, saber).

In other words, any object with a sharp edge can be considered cutting only at the time of injury if the wound is formed as a result of a sliding-pressing mechanism (pulling along a straight or curved path with simultaneous pressure on the tissue being cut perpendicularly or at an angle).

If you strictly follow the definition, then as typical representatives of sharp cutting objects, we can name the blades of a safety and safety razor, a metal disc sharply sharpened around the circumference, an edge of metal or glass that does not form sharp corners, etc.

MORPHOLOGICAL CHARACTERISTICS OF THE CUT WOUND

The structural elements of the cut wound are the edges, ends, walls and bottom. Each of these structural components has a number of features that make it possible to diagnose a cut wound.

The shape of the wound. The appearance of the wound is determined by a set of parameters: the degree of gaping, localization, position of the body at the time of damage, the nature and direction of movement of the cutting object, etc. The hour after the impact of the blade along a rectilinear trajectory, the wound has a linear shape, which later transforms into a spindle-shaped or even oval ... As a rule, the deeper the wound, the more muscle fibers are damaged, and hence the greater the degree of divergence of its edges, due to contraction crossed muscles. An incised wound can have an arched shape if the traumatic object moves in an arc, or when the cutting tool is exposed to an acute angle with respect to the injured surface that has any anatomical bulges or curvatures.

Zigzag wounds are formed when the folds of the skin are completely cut. Sometimes, as a result of a single traumatic effect, the skin fold does not intersect completely, while two wounds may form, located in a step-like manner parallel to each other. With the tangential effect of a cutting object, almost parallel to the damaged surface, there is often a complete or partial separation of the skin fragment with the underlying soft tissues and the subsequent formation of a round or oval wound surface.

The protruding anatomical formations under the action of a cutting object can be completely or partially separated from the body (tip of the nose, auricle, mammary gland).

A distinctive feature of a cut wound is its uneven depth throughout. It is, as a rule, maximum in the initial and middle third of the wound, which is due to the greater pressing force on the blade of the cutting tool at the beginning of its movement, and is minimum in its final segment. If you make a tissue incision in the longitudinal direction through the plane of the wound, its profile will look like a folded petal. In cross-section, the cut wound has the shape

of a wedge or triangle, the base of which is the dispersed edges of the wound, and the top is its bottom.

An important feature of a cut wound is the predominance of its length over depth. However, in some parts of the body, due to the peculiarities of the anatomical structure, deep cut wounds may occur, the length and depth of which are equal (for example, on the neck).

The edges of the wound. As a rule, even, smooth, not crumbly, unseed, without bruising in the surrounding skin. When exposed to objects that have a blade with significant defects (notches, deformations), a rough or rusty surface, in some cases, there may be areas of uneven deposition of one or both edges and their unevenness.

Due to the elastic properties of the skin and the contractility of the muscles, the edges of the wound in its middle part diverge. The degree of gaping of the wound is determined by the direction of its length in relation to the Langer lines on the skin. The closer to the right angle between the direction of the skin fibers and the length of the wound, the greater the gaping. Posthumous wounds gape slightly. The cut wound, as a rule, does not have a tissue defect, so its edges are easily comparable.

Over time, there is a drying out of the skin in the area of the edges of the lesion, which outwardly resembles a precipitation border. When treating the surface of the wound with an acetic-alcohol solution, the skin regains its former elasticity and color, and it becomes obvious that the edges of the wound are not sagged.

The ends of the wound. The cut wound always has sharp ends, since their formation is due only to the sliding movement of the cutting edge of the blade, the result of which is displayed in the form of the formation of acute-angled ends along the edges of the wound. In some cases, at the moment of removing the cutting object from the wound, the initial trajectory of its movement may change and an additional incision appears at one of the ends, extending from the main one at one angle or another.

If the blade along its entire length did not have defects (deformations, notches), the cut wound may end with a superficial incision that continues it. Sometimes a scratch is determined at the end of the wound, the formation of which is due to the presence of any defect on the blade, which has not a cutting, but a tearing effect with the formation of a linear abrasion.

The walls of the wound. Formed by several layers of soft tissue that fall under the blade at the time of damage. In the overwhelming majority of cases, the walls are even, smooth, located either vertically with the perpendicular action of the object in relation to the surface of the skin, or one wall is beveled, and the other is undermined if the cutting object acted at an angle.

The bottom of the cut wound is formed as a result of the convergence of the walls at an acute angle and can be formed by various tissues (muscles, PZhK, tendon aponeurosis, bone, cartilage), depending on the anatomical and topographic features of the injured area of the body, the sharpness of the blade, and the force of pressure on the cutting edge. In the overwhelming majority of cases, the bone is an insurmountable obstacle to the cutting tool (with the exception of thin children's bones, ribs, cartilage). Therefore, sometimes the depth of cut wounds depends not only on the sharpness of the blade and the strength of the pressure exerted on it, but also on how deep the bone is located under the skin. In this case, incisions are formed on the surface of the bone, sometimes penetrating through the periosteum and the cancellous substance. Irregularities and roughness of the blade leave multiple parallel surface ridges and grooves on the dissected surface of cartilage or bone. The depth of the grooves and

the height of the ridges, as well as the peculiarities of their mutual arrangement, constitute a set of individual features that make it possible to identify a specific traumatic object.

It should be noted that cut wounds are characterized mainly by external bleeding, the intensity of which is directly proportional to the caliber of the damaged vessels.

The relatively shallow depth of cut wounds, the absence of a defect and a large number of necrotic nonviable tissues, as well as good conditions for self-cleaning create favorable prerequisites for the healing of such wounds.

FEATURES OF CUT WOUNDS APPLIED BY OWN AND OUTSIDE HAND

Deliberate self-harm with the use of cutting objects (safety razors or safety razors) is not so rare in forensic practice. As a rule, wounds are localized in open areas of the body that are accessible for the action of one's own hand (anterolateral surfaces of the neck, anterior surface of the wrist joint, the area of the elbow bend). Self-harm can be multiple and located in one place, parallel to each other.

As a result of the initial application of the blade to the skin before applying the wound (trying on), small cuts or notches are formed at its initial end, the so-called "traces of trying on". A distinctive feature of cut self-harm is their uneven depth, which is inherent in cut wounds in general, and even more so by one's own hand. This is due to a pronounced pain reaction at the end of the movement, which is accompanied by an involuntary weakening of the pressure on the cutting object.

Always remove the injured part of the body from clothing before causing injury.

Slash wounds inflicted with the intent of murder have a number of distinctive features. Usually they are localized on the anterior and lateral surfaces of the neck, differ in pronounced depth, their lengths are oriented at different angles to each other. In cases of active struggle and self-defense, cut wounds are found on the palmar and back surfaces of the victim's hands, as well as on other parts of the body (face, forearms).

SHEARING-CUTTING OBJECT DAMAGE

DEFINITION, CLASSIFICATION, DEVICE AND MECHANISM OF ACTION

A piercing-cutting tool is any object that has sufficient density to penetrate the damaged tissue and structurally combines two traumatic elements: a sharp stabbing end and a sharp cutting edge.

It should be emphasized that this definition does not reflect only the design features of an object, it rather correlates with the mechanism of its action, since a tool with the above characteristics can cause not only stab and cut damage, but also cut damage. In this case, the nature of the resulting wound is determined by the method of its application.

The most numerous and typical representatives of piercing and cutting tools are various types and types of knives. According to the design features of the blade, they can be divided into two types: single-edged and double-edged. The cross-section of knives with one-sided sharpening has a triangular-wedge-shaped shape, the blade of a double-edged knife in cross-section has the shape of a narrow elongated rhombus. In addition to knives, objects with a piercing-cutting action include a piece of metal, a shard of glass, extended branches of scissors, etc.

The whole process of the formation of a stab and cut wound includes two phases: the introduction and extraction of the blade.

In turn, the first phase can be conditionally divided into two successive stages:

1. Tension and compression of the skin and underlying soft tissues under the action of the tip, followed by their rupture.
2. Cutting the injured tissues along the trajectory of the blade from the side of the sharp edge and simultaneously pushing them back with or without a break in the area of contact with the back.

At the moment of extracting the blade, the degree of severity of the cutting action of the blade varies. It is minimal if the extraction trajectory coincides with the blade sinking trajectory. The length of the resulting wound most closely matches the maximum width of the blade at the level of immersion.

When the blade is extracted with an emphasis on the blade, the cutting action of the latter is more pronounced and an additional cut is formed. The direction of the latter coincides with the direction of the main incision, if during extraction the blade did not rotate around the longitudinal axis, and the body of the wounded was motionless. In this case, the length of the resulting wound does not correspond to the width of the blade at the immersion level. If the moment of extracting the blade was accompanied by its rotational movement around the longitudinal axis or a change in the position of the victim's body, the directions of the main and additional cuts do not coincide.

MORPHOLOGICAL CHARACTERISTICS OF THE PUNCH-CUT WOUND

Skin lesions

Possibilities for diagnostics of stab and cut injuries are determined, first of all, by the degree of display of the structural properties of the wounding tool in the properties of the damage caused to it. In other words, the greater the number of structural elements of a sharp weapon takes part in the formation of a wound, the more forensic medical information can be extracted during its examination.

Stab and cut injury includes an entrance wound, a wound channel, and sometimes an exit wound.

The entrance wound has edges and ends, which, going deeper, pass into the walls and ribs of the wound channel, respectively. The exit wound, like the entrance wound, has edges and ends.

Entrance wound shape. The appearance of a stab wound depends on a number of parameters: the design properties of the traumatic tool, the direction of its action, the physical properties of the damaged surface, etc. In this case, the wound with passively divorced edges can have a spindle-shaped, oval, slit-shaped, triangular-wedge-shaped, angular and crescent shape. After the edges are brought together, the skin wound, due to the absence of a tissue defect, takes on a linear shape.

The spindle-shaped form is characteristic of wounds oriented at an angle to the elastic fibers of the skin and reflects its ability to contract, due to its own elasticity and additional contraction of the crossed muscles. The closer to the right angle between the length of the wound and the direction of the elastic fibers of the skin, the greater the degree of gaping of the wound. In such cases, the latter can take the form of an elongated oval.

The location of the zone of maximum divergence of the edges of damage depends on the properties of the blade. When using a tool with a double-sided sharpening, the greatest degree of divergence of the edges is noted in the center of the wound. If a blade with one blunt edge acted, the predominant divergence of the edges of the skin wound is observed in the area of impact of the butt.

In cases where the length of the wound is oriented parallel to the Langer lines of the skin, the gaping may not be pronounced, and the damage takes on either a slit-like or wedge-triangular shape (if a single-blade blade was used).

Sometimes a stab-cut wound can have an angular shape, the formation of which is possible in cases when the extraction of the blade is carried out with an emphasis on the blade and simultaneous rotation around the longitudinal axis. The additional incision formed in this case is located at a certain angle (mainly obtuse) with respect to the main one. In addition, the formation of angular wounds is possible under the condition of the action of the blade with a bevel of the butt at a very acute angle to the skin surface, due to its tension in the area of contact with the point.

The edges of the wound. To determine and evaluate the properties of the blade of a piercing-cutting tool, it is necessary to investigate the morphological parameters of the main section.

As a rule, on visual inspection, the edges of the main incision are even. And only with a stereomicroscopic examination, a slight waviness of the edges, corresponding to small irregularities of the skin, can be determined.

The edges of the main incision also have a number of other equally important features that facilitate the diagnosis of stab and cut injuries. These include, first of all, precipitation, drying and pollution.

The degree of sedimentation along the edges of a skin wound during incomplete immersion of the blade is determined by a number of its physical parameters. First of all, thickness: the thicker the blade, the wider and deeper the zone of deposition (with a sufficient thickness of the wounding tool, the smooth edges of the wound can be deposited due to sliding of the clothes pressed against the body). The nature of the microrelief of the lateral edges of the blade is also important (rough surfaces, due to more significant friction, contribute to the sloughing of the epidermis). The intensity of sedimentation depends on the speed of immersion of the blade into soft tissues: with slow penetration of the edge of the damage, due to the tension of the skin, they are carried deep into the resulting wound, thereby increasing the contact time of the epidermis with the lateral surfaces of the edges of the blade.

When exposed to a blade with two blades, which has a planar-rhomboidal section, more intense areas of sedimentation are determined in the center of the edges of the wound, i.e. at the point of contact with blunt ribs. If a one-sided blade was used, the precipitation zone is more pronounced in the area of impact of the butt.

As a rule, the sediment is in the form of narrow stripes 0.5-1 mm wide along the edges of the wound. Often, their identification when viewed with the naked eye is very difficult. In such cases, it is recommended to resort to a stereomicroscopic examination, with the help of which it is possible to detect areas along the edges of the wound where the stratum corneum is absent.
It should be noted that sagging of the edges is a criterion for entry damage, since not observed in the area of the exit wound.

Drying of the edges of the wound is observed in all cases, both in the area of the entrance and in the area of the exit injury. As you know, moisture evaporation occurs more intensively in those areas of the skin, the integrity of the epidermis of which is violated. Thus, the visible drying zone is determined along the edges of the wound in the areas of sieged skin, which, due to evaporation of moisture, becomes denser and acquires a yellow-brown or dark-brown color.

The presence of a rubdown (contamination) border along the edges of the entrance damage is an extremely variable sign. Theoretically, at the moment of contact of a traumatic agent with the human body, traces of its effects should always remain on the skin in the form of overlays or impurities. However, the severity of these marks in the area of the wound is determined by the degree of contamination of the wounding blade, as well as by the density and layering of clothing. When stabbing with a knife with a sufficiently contaminated blade on the bare surface of the body, or through loose thin clothing, the wiping border can be seen with the naked eye.

The ends of the wounds. The formation of the ends of the stab-cut wound occurs at the moment of the immersion of the blade and during its subsequent extraction from the wound. In this case, the end of the damage from the side of the action of the blade looks acute-angled. This is due to the direct cutting of soft tissues at the moment the blade is immersed.

The appearance of the opposite end of the wound is determined by the shape of the cross-section and the properties of the butt part of the blade (thickness, sharpness of its ribs), as well as the force of pressure of the butt on the skin, the speed and depth of immersion of the blade. In cross-section, the blades are either rounded or U-shaped with clearly defined rectangular or slightly rounded edges.

When exposed to a blade with a rounded back, the ends of the wounds are usually rounded. Sometimes, when striking with significant emphasis on the butt, the ends can acquire a U-shape. However, if the thickness of the backing is insignificant (less than 1 mm), it is possible to form sharp-angled ends, which are very difficult to distinguish from those formed under the influence of the blade.

If a U-shaped butt with clearly defined rectangular ribs acted, U-shaped ends of the wounds are formed. In this case, even with a slight pressure of the butt, tears or notches (in the presence of pronounced, "sharp" edges of the butt) of the skin may occur, obliquely extending from the corners of the blunt end and giving it the shape of the letter M (when the edges of the wound are brought together, such ends become T-shaped or Y -shaped). It should be noted that the tears have finely sinuous, uneven edges, in contrast to notches, in which the edges are even. In some cases, only one tear (notch) is formed, when the blade was immersed with an emphasis on one of the side faces, or if one edge of the butt is more pronounced than the other.

The impact of a U-shaped butt with rounded edges contributes to the formation of both U-shaped ends and rounded ends, and with strong pressure they can also have an M-shape.
Sometimes it is rather difficult to establish the shape of the ends of the wound during a macroscopic examination, therefore, one should not neglect the possibilities of stereomicroscopy, which makes it possible to accurately determine the morphological features of injuries.

Often, stretching of the skin distorts the original shape of the ends of the wound, therefore, in order to identify their true properties, the study must be carried out by combining and separating the edges, slightly displacing them relative to each other. This technique allows you to restore the original shape of the ends of the wound.

In the area of the butt end of the wound, in the overwhelming majority of cases, sedimentation is found, which is better expressed on the skin area in the interval between tears and is formed as a result of friction of the butt when the blade moves. The degree of sedimentation is different: from a slight violation of the integrity of the surface of the stratum corneum, determined only by microscopic examination, to a clearly pronounced border, observed with the naked eye.

To establish the nature of the ends of the wounds, a histological examination of plane sections of the skin, made parallel to its surface, can be applied. In the area of the blunt end of the wound, there is some thickening of collagen and elastic fibers due to the displacement and compression of the skin under the action of the back. In the presence of tears or notches, this sign is absent. From the side of the sharp edge of the blade, the thickening of the fibers is not observed due to their complete intersection.

In cases where double-edged blades were used to inflict damage, both ends of the resulting wound will be acute-angled, as a rule, without sediment. Similar wounds can also be formed under the action of one-sided sharp blades, the backing thickness of which does not exceed 1 mm.

It should be noted that the blunt end of the wound, formed under the action of a thicker butt, better reflects its properties. This is due to the greater degree of stretching of the skin, which increases the force of friction between the moving butt and the skin.

The degree of display of the design features of the butt in the structure of the skin wound also depends on the speed and depth of the blade immersion. The slower and deeper the penetration, the more pronounced the morphological features of the ends of the wounds from the side of the impact of the butt.

Thus, summarizing the above, it should be noted that the morphology of the stab wound is determined not only by the design features of the traumatic tool, but also by the mechanism of its action.

Thus, a characteristic feature of the damage resulting from the extraction of the blade with an emphasis on the blade is the formation of an additional incision in the area of the acute-angled end of the wound. In practice, it is very important to be able to distinguish it from the main cut, which carries information about the width of the blade at the level of immersion and its other properties. The parameters of the additional cut indicate only the direction of the blade action and the degree of its sharpness. An additional incision usually departs at some angle from the main one and always ends with a sharp end, sometimes turning into an incision or scratch. Also around the edges an additional incision does not show signs of skin sagging, and drying is less pronounced. Because during immersion, at the moment of the formation of the main incision, the blade is tightly covered by the dissected tissues, it is completely wiped down to the level of immersion. With the subsequent removal of the tool from the wound, the blade is not tightly enveloped, therefore, there is no contamination along the edges of the additional cut.

In a forensic study of skin wounds, it is always necessary to determine their length (the width of a stab wound does not mean the absence of a tissue defect). With the vertical impact of the blade, the correspondence between the length of the wound and the width of the blade will be maximum. In most cases, the length of the stab wound is less than the width of the blade at the level of immersion, which is explained by the contractility of the skin and underlying muscles, especially when the wound is located at an angle to the direction of the Langer lines.

In some cases, the length of the wound corresponds to the width of the blade (dense little

stretch skin, the location of the injury along the connective tissue fibers). Sometimes the length of the wound predominates over the width of the injured part of the piercing-cutting tool (when it is inserted obliquely, removed with an emphasis on the blade or turned around the longitudinal axis). In the latter case, an additional incision is formed, which significantly increases the size of the damage. Thus, the width of the blade at the level of immersion is determined by measuring the length of the main incision after preliminary alignment of the edges of the wound.

Wound channel. The study of the wound channel makes it possible to judge the direction and force of the blow, the relationship between the attacker and the victim, the depth and severity of the injury, as well as some of its features. For example, a double wound channel in the presence of one entrance damage indicates that a repeated immersion of the blade took place without completely removing the weapon from the wound.

A wound channel is a set of injuries formed along the trajectory of a wounding weapon. As noted above, it includes walls corresponding to the side edges of the blade, and ribs corresponding to the action of the back portion and the blade.

The morphology of the wound canal is determined by the properties of the tool and the direction of its action, the force of the blow, the localization of the wound, and the density of the damaged tissues. Within the skin and subcutaneous fat, the walls of the wound canal are even and smooth.

If the blade acted normally, the walls of the wound channel have a direction perpendicular to the skin, i.e. are located vertically.

When immersed with an emphasis on one of the side faces, the walls of the wound channel are located at an angle corresponding to the direction of inclination of the blade.

The edges of the wound channel, formed as a result of the action of a one-sided sharp blade, differ from each other. The rib corresponding to the butt part can be U-shaped, rounded or even sharp. The opposite edge, corresponding to the action of the blade, is predominantly acute-angled. However, in In cases of complete immersion of the blade and penetration into the wound of the beard or heel, the rib may have a rounded appearance.

The direction of the edges of the wound channel depends on the direction of the blade. With perpendicular immersion and extraction, the channel ribs are vertical. If the blade acted with predominant pressure on the butt part, the corresponding edge will be beveled, and the opposite one will be undermined. In cases of immersion or extraction with an emphasis on the blade, the opposite picture is observed.

The study of the wound channel is very important for determining the length of the blade, the direction of its action, the force of the blow.

The determination of the length of the blade is carried out by determining the depth of the wound channel before removing the internal organs. In practice, two research methods are used: layer-by-layer measurement of the thickness of damaged tissues along the wound channel (in the skin, adipose tissue, muscles) and careful probing (in internal organs).

The total length of the submerged part of the blade when the body cavities are injured consists of the thickness of the damaged clothing, the length of the canal in the skin, subcutaneous fatty tissue and muscles, the distance between the damage on the pleura (peritoneum) and damage on the surface of the internal organ, the depth of the wound canal in the organ itself. Difficulties arise when hollow organs are damaged (intestines, stomach, aorta, heart). In this case, it is not known how deep the blade penetrated into the cavity, which greatly

complicates the determination of the length of the wound channel, and, consequently, the length of the blade.

When continuous channels are formed in the muscles and parenchymal organs, which have sufficient density and quite accurately reflect the shape of the injuring blade, it is advisable to fill them with polymer plastic masses (paraffin, wax, gypsum), which makes it possible to obtain an impression of the wound channel that repeats the shape of the end part of the injuring instrument.

A blind wound canal, especially in parenchymal organs such as the liver and kidneys, can be exposed to radiography by injecting a small amount of contrast agent (iodolipol) into the cavity. The introduction of a few drops of dye (black ink) into the cavity of the wound canal during the subsequent opening of the canal helps to reveal the shape of its end part and thereby judge the shape of the damaging object.

However, establishing the length of the wound channel is a rather difficult task.

The difficulty in resolving this issue is determined by several factors.

First, the possibility of establishing the length of the blade by the depth of the wound channel depends on the anatomical features of the damaged part of the body. So, for example, with penetrating wounds of the abdominal region, the depth of the wound channel can quite significantly prevail over the length of the blade, which is explained by the softness and pliability of the abdominal wall at the time of injury. For this reason, relatively short blades are capable of inflicting deep damage. In addition, a significant discrepancy between the length of the blade and the depth of the wound channel is determined by the different position of the organs at the time of the formation of damage and during research. It depends on the amount of intra-abdominal pressure, the level of standing of the diaphragm, the position of the victim's body at the moment of impact. Hollow organs (stomach, intestines) collapse and shift after damage, changing their original position.

A similar picture is observed with penetrating wounds of the chest and its organs. As a result of the developed pneumothorax, the lung collapses to one degree or another and decreases in volume. This leads to an increase in the distance between the lesion on the parietal pleura and the wound on the surface of the lung. In addition, the depth of the wound channel in the damaged lung is less than the length of the part of the blade that penetrated it. For these reasons, almost always when the chest is wounded, there is a discrepancy between the depth of the channel and the length of the blade.

Secondly, the depth of the wound channel reflects only the length of the submerged part of the blade. And only in the presence of traces of complete immersion of the latter (areas of limited sedimentation from the impact of a beard or handle), one can judge its full length.

Considering the above, it should be noted that the identification of a piercing-cutting object based on the autopsy results is practically impossible. With the same piercing-cutting object, depending on the direction of its action, anatomical features of the injured area, skin condition, muscle tone, displacement of clothing, posture of the victim, it is possible to form stab and cut wounds, sometimes very different from each other.

Output damage. It is observed in cases of the formation of through stab-cut wounds (mainly on the upper or lower extremities). The shape of the output damage corresponds to the shape of the input damage. The edges of the damage are even, without sediment and dirt, the border of drying is less pronounced than in the area of the entrance wound. There are never any signs of impact from the barb, stop or handle.

The ends of the output damage, corresponding to the butt part of the blade, as well as the input ones, can be rounded, U- and even M-shaped. The opposite ends are sharp.
The length of the output fault is always less than the input fault. The number of crossed hairs at the edges of the entrance wound is much greater than in the area of the exit.

DIFFDIAGNOSTICS OF WOUNDS APPLIED BY OWN AND OUTSIDE HAND

In forensic practice, it is often necessary to decide on the possibility of causing injury to the victims themselves. The solution to this issue helps in determining the type of death (homicide or suicide) in cases of fatal injuries, and also allows you to testify or refute the fact of self-harm when examining living persons.

Differential diagnosis is carried out by an expert on the basis of a thorough examination of wounds, taking into account their localization, the number, depth and direction of wound channels, the nature of damage to clothing, the presence or absence of signs of struggle and self-defense.

The injuries caused by the victim himself are naturally located in those anatomical areas that are available for the action of his own hand. As a rule, this is the anterior surface of the chest in the region of the projection of the heart, less often the anterior surface of the abdomen. The presence of wounds on areas of the body that are either inconvenient or inaccessible for striking with their own hand testifies in favor of the action of an extraneous hand (back surface of the body, neck, limbs).

The nature of the interposition of stab wounds is of some importance. Their unsystematic, irregular arrangement in various anatomical regions at a considerable distance from each other suggests that the blows were delivered by an extraneous hand.
Stab and cut injuries occurring under various conditions can be both single and multiple. In itself, the number of injuries has no diagnostic value, therefore, the location and depth of the wounds must also be taken into account.

Multiple suicidal wounds are usually located in a limited area (usually in the heart). Most of them are superficial and only one or two are penetrating with damage to vital organs. Due to the development of shock and loss of consciousness, further deep damage is impossible.
Multiple wounds inflicted with an extraneous hand for the purpose of killing can be located on different parts of the body, and most of them are characterized by considerable depth.
Indisputable proof of the action of an extraneous hand is the presence of a deep single wound in the anatomical region, inaccessible to one's own hand.

Determination of the directions of wound channels in case of multiple injuries has some diagnostic value in combination with other signs. In the overwhelming majority of cases, wounds inflicted with one's own hand are characterized by a parallel and unidirectional arrangement of wound channels.

Signs of struggle and defense (bruises, abrasions, wounds of various localization and depth) are extremely important for the differential diagnosis of self-harm, the fact of which, as a rule, indicates the action of an outside force.

However, the absence of signs of a struggle does not allow us to assert that the injuries were inflicted by the victims themselves, since injuries from the action of an extraneous hand could have been inflicted suddenly or to a person who was in a helpless state.

It should also be noted that the majority of self-harm is applied to exposed parts of the body, while the action of an unauthorized hand is characterized by damage to clothing in the projection of bodily wounds.

It is important to note that a comprehensive assessment of the entire the totality of the available signs, taking into account the results of the inspection of the scene.

DAMAGE BY CHILLING TOOLS

Chopping tool - an object with a sharp edge, significant mass, wedge-shaped section and causing damage by the mechanism of impact. Chopping tools combine the characteristics of both sharp and blunt objects. With the former, they are related by the presence of a sharp edge and the ability to cause cut wounds. Like blunt objects, chopping tools have significant mass and high kinetic energy at the time of damage formation. As a result, the resulting chopped wounds combine the signs of the impact of blunt and sharp weapons. At the same time, depending on the sharpness of the blade, either signs of a cut or bruised wound predominate in the formed damage.

Axes, cleavers, mowers are classic representatives of chopping tools. Chopped damage can be caused by massive kitchen knives, checkers, sabers, scimitars, machetes, shovels, hoes. In the practice of a forensic expert, most often it is necessary to deal with various types of axes.
In the mechanogenesis of the formation of a chopped wound, the decisive role is assigned to the direct shock effect, as a result of which the soft tissues are initially compressed with simultaneous pressing against the underlying bones and their subsequent dissection. As the tool is introduced into the tissue, its lateral edges move apart the edges and walls of the forming chopped wound.

Of course, an ax can cause not only chopped, but also cut (when pulling with simultaneous pressure), as well as stab-cut (with the stabbing effect of the toe or heel) damage.

MORPHOLOGICAL CHARACTERISTICS OF THE CUT WOUND

Like other injuries caused by sharp objects, chopped wounds have edges, ends, walls, and a bottom.

The nature and morphological features of chopped wounds are determined, first of all, by the amount of kinetic energy imparted to the tissues, which in turn depends on the size and mass of the weapon, as well as the speed of the impact. Factors such as the sharpness of the blade and the nature of the injured tissue, of course, also contribute.

The shape of the wounds. In forensic practice, the following forms of chopped wounds are most often found: spindle-shaped, oval, slit-like, triangular and arcuate.

The necessary conditions for the formation of spindle-shaped or oval wounds, differing only in the degree of gaping, are their location perpendicular or at an angle with respect to Langer's lines and the impact of only the middle part of the blade, without involving the toe or heel in the wounding process. If there is no defect in the fabric, and the edges are easily matched, then after them information the wound takes on a linear shape. The formation of a slit wound is possible in cases of its location parallel to the direction of the skin fibers.

If the toe or heel is involved in the formation of the lesion, the formation of wounds of an irregular triangular shape is possible.

The arcuate shape of the wound occurs when a chopping object acts at an angle to the surface of the skin.

The edges of the wounds. Usually smooth, due to cutting (dissection) of tissues under the influence of the sharp edge of the working part of the ax. But if a dull blade or a blade with defects acted, a fine unevenness (scallop) of the edges is noted, caused by crushing of the skin and is clearly distinguishable during stereomicroscopic examination.

A very characteristic sign of a chopped wound is the sagging of its edges, which is especially clearly detected during stereomicroscopic examination and in the study of histological sections of the skin. Precipitation is formed by squeezing the skin between the blade and the subcutaneous tissue at the time of impact. At the same time, the epidermis "breaks down" and is carried away into the wound. At the same time, friction of the edges of the damage against the lateral surfaces of the ax wedge occurs. The severity of the sedimentation zone is determined by the degree and angle of the blade sharpening, the thickness of the ax wedge, the contamination of its working part, the direction of the strike plane in relation to the surface of the skin.

When using a chopping tool with a blunt blade, a pronounced sagging of the edges of the wound is noted, as well as in cases of using axes with a significant sharpening angle of a sharp edge, or with an uneven, rough surface of the cheeks. The degree of sedimentation is directly proportional to the thickness of the ax wedge.

If the blow was inflicted at some inclination in relation to the injured surface, uneven settling of the edges of the damage is noted. The edge of the wound on the side of the sharp angle of inclination of the blade is always more siegeable than the opposite, which indicates the direction of the action of the traumatic object.

In cases of using tools with significant contamination on the working surface (rust, grease), rubbing areas are also observed along the edges of damage, often masking sedimentation zones. Using some laboratory techniques (diffusion-contact method, spectral analysis), in the area of the wound edges, it is possible to detect microparticles of the metal from which the traumatic instrument is made.

The edges of chopped lesions can be bruising due to compression and bruising of soft tissues with a wedge of an ax, which is especially pronounced in cases of localization of lesions in those anatomical regions where the bone is close.

Damage to the hair along the edges of the chopped wound is characteristic. When exposed to a sufficiently sharp blade, an even intersection of the hair is observed, the plane of which corresponds to the direction of the plane of the cut of soft tissues. If the blade acted with its middle part, the intersection of the hair is noted only in the middle part of the wound, and along the periphery, in the area of the ends, the integrity of the hair not broken, and they hang over the wound gap in the form of bridges. According to the action of the sharp edge, the hair shafts can be somewhat creased.

When hitting with a heel or toe, all the hairs along the edges of the injury are crossed and there are no “bridges”.

Hair may not be completely separated if an object with a blunt or deformed blade was used to inflict damage. In such cases, along with evenly crossed hair, there are crushed, crushed, torn at different levels, and even dislocated hair along the edges of the wound. Similar damage occurs when exposed to solid blunt objects.

The ends of the wounds. The shape and characteristics of the ends of the chopped wound depend on the depth of immersion of the ax wedge, its thickness and the position of the weapon at the moment of impact. In cases where the blow is applied with little force, only the middle

part of the blade takes part in the formation of damage and the wedge does not fully submerge. In this case, a spindle-shaped wound (if the tool acted normally) or arcuate (when acting at an angle) with sharp ends is formed. Often in such cases, provided that the blade was sharp enough, and only the skin and subcutaneous fat were damaged, a chopped wound is practically no different from a wound caused by a cutting tool.

Sometimes (with varying degrees of inclination in the sagittal plane), only the heel or toe of the wedge takes part in the formation of the damage, which individually can be considered as piercing-cutting elements of an ax. The resulting wound takes on a triangular-wedge shape. One of its ends, corresponding to the action of the blade, is sharp, and the opposite, from the side of the action of the expanding part of the wedge, is U-shaped or rounded, with more or less pronounced deposition. According to this end, obliquely oriented additional ruptures of the skin are often formed, due to the pressure of the edges of the ax wedge on it. As a result of this, the end of the wound can acquire a L or T-shape. The thicker the wedge, the more pronounced the width of the U-shaped end of the injury and the length of additional skin breaks.

In the area of the sharp end of the wound on the skin, there can be observed a "trace-impression" in the form of a narrow linear abrasion (scratch), which is most pronounced at the wound and disappears at a distance.

When a blow is struck with significant force, the wedge is completely immersed and all its structural components (heel, toe, blade, side edges - cheeks) take part in the formation of damage. The ends of such a wound are sagged and have a U-shaped or rounded shape, small tears and tears of the skin can depart from them.

Under the action of the chopping object at an angle, a patchwork wound occurs, one of the edges of which, at the moment of impact with the blade surface, forms an acute angle, displays traces of sliding of the wedge in the form of sedimentation.

Walls of wounds. On visual examination, they appear even and smooth. When examining them with a magnifying glass, small irregularities are found, especially as you approach the bottom of the wound, where there are signs of tissue crushing.

The direction of the wound walls is due to the mechanism of action of the chopping tool. If the plane of impact is oriented perpendicular to the injured surface, the walls are vertical. In those cases when the chopping object acted at a certain angle, the walls of the wound have a corresponding slope in one direction or another, one of them is beveled, the other is undermined.

The soft tissues that make up the walls of the wound can have various kinds of macro- and micro-overlays, the nature of which depends on the degree of contamination of the traumatic part of the chopping tool.

The bottom of the wound. One of the hallmarks of chopped damage is its depth. They are quite deep and, as a rule, affect the underlying bones. In the bottom of the wound, crossed hair, bone fragments, threads of clothing, fragments of crushed muscles and subcutaneous adipose tissue are found. When struck with blunt instruments, tissue bridges can form at the bottom of the wound.

An important feature of chopping tools that distinguishes them from the previously considered sharp objects is damage to the underlying bone tissue. The nature of bone damage is determined by the properties of the object itself (sharpness of the blade, thickness, level of immersion, kinetic energy), as well as the structure (tubular, flat) and properties of the bone (density, elasticity).

In forensic practice, damage to flat bones (mainly the skull) is more common, which can be slit-like, comminuted, or in the form of superficial incisions.

Slit-like damage occurs in cases of impact of a chopping object with a relatively thin wedge and a sharply sharpened blade. Due to the abrasive and sealing action of the lateral faces (cheeks) of the ax wedge, a bone defect is always formed. As in the skin, the edges and ends of bone defects have their own characteristics, depending on the mechanism of action and the level of immersion of the traumatic instrument. Impacts can be delivered either in a perpendicular plane or at an angle.

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