АРХЕОЛОГІЯ І ПРИРОДНИЧІ НАУКИ

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CASE STUDY OF THE SKULL TRAUMA TREATMENT IN INHUL CATACOMB CULTURE BURIAL

In the Dnipro steppe territory during the Middle Bronze Age, a high frequency of skull trepanation was recorded, indicating the region as a center of cranial surgery. Evidence of medical intervention for the treatment of the impression fracture was found on the skull of an individual of the Inhul Catacomb culture from the barrow near the village of Novoivanivka, Dnipro region.

Keywords: *Cranial surgery, Middle Bronze Age, North Pontic region, Inhul Catacomb culture.*

The skull injuries of the catacomb population of the Northern Pontic region have repeatedly been top of interest for various researchers (Зіневич, Круц 1968; Данилова, Корпусова 1981; Круц 1984, с. 78—80; Schultz 1991, S. 33; Ушкова, Козак 2014). The observed growth in the frequency of such trauma in the Middle Bronze Age can be explained by the intensification of contacts between populations due to migratory processes (Szmyt 1999; Ushkova, Kozak 2024).

According to D. J. Wölfel, the widespread use of slingshots and stone clubs in the Western European Neolithic led to the development of cranial surgery (Wölfel 1936; Ackerknecht 1971). The injuries caused by the new weaponry, specifically battle stone axes, used by the Catacomb culture tribes (Клочко 2001) were more complicated and caused more damage compared to those observed in the Yamna culture (Ушкова, Козак 2011; 2014). The development of battle weapons during the Bronze Age may have catalyzed the rapid evolution of therapeutic, surgical techniques.

The most notable evidence of skull surgery is trepanation. The presence of a significant number of healed trepanations indicates a high survival rate and suggests that the ancient surgeons or healers who performed these operations possessed a high skill level (Papagrigorakis 2014; Arena, Larocca, Gualdi-Russo 2022; Ushkova, Kozak 2024). However, surgical interventions were not limited to trepanations.

Trepanation as an action (Clowes 1926) involves the removal of a section of the cranial vault without damaging the meninges and the brain itself (Steinbock 1976, p. 29). The procedure is undertaken by means of «scraping, cutting or drilling a hole in the skull» (Verano 2016, p. 1) and is a deliberate process driven by a specific purpose. The size and depth of the operations can vary. According to D. Ortner and W. Putschar, «the surgeon can remove the outer table of bone and diploe, or… he can remove both tables of bone, exposing the dura» (Ortner, Putschar 1981, p. 97).

It is assumed that the trepanations were performed for therapeutic or ritual / magical purposes (Campillo 1984; Campillo, Mercadal 1988; Gresky et al. 2015).

In many cases, trauma and its consequences were considered the most plausible reason for such an operation (e. g., Wölfel 1936; Verano 2016; Redfern, Roberts 2019, p. 268; Weber, Wahl 2022; Ushkova, Kozak 2024). R. T. Steinbock stressed the primary objective of trepanation to be the reduction of intracranial pressure caused by edema or hemorrhage due to depressed cranial vault fractures (Steinbock 1976, p. 31). A review of ethnographic studies indicates that trepanning was also used in simple societies to treat various symptoms, including headaches, migraines, and epilepsy (Meschig 1983, p. 150). Another purpose for trepanation, as described by the Kisii people of Africa and earlier by Hippocrates, was the diag-

nosis of traumatic injuries (Meschig 1983, p. 151; Hippocrates 1999, p. 33—34).

Ritual intravitam trepanation was performed for two main reasons: initiation or expulsion of an evil spirit from the person (Sigerist 1955, p. 197, 206; Karolyi 1968; Медникова 2001).

The increase in the number of detected cases of trepanation in recent decades has revealed an increasing proportion of trepanations caused by trauma (Ullrich, Weickmann 1965; Meschig 1983; Czarnetzki, Pusch 2006; Lidke 2006; Ullrich 2006; Weber, Wahl 2022; Ushkova, Kozak 2024). Nevertheless, there are difficulties in determining the existence or nature of injury in cases where the lesion has undergone full or even partial healing. Consequently, it can only be suggested that the majority of surgical procedures conducted at the site of impact were undertaken to remove fragments in cases of penetrating and comminuted injuries or to clean the edges of the injury. Otherwise, trepanation openings intended to address chronic sequelae of trauma or other conditions not directly related to injury may be observed at a considerable distance from the initial trauma site. In such instances, the penetration of the inner table could be necessary.

Damage to the dura mater, including in the area of the venous sinuses, was considered life-threatening in ancient times (Sigerist 1955, p. 356). It is suggested that this knowledge was acquired empirically during the Neolithic period (Weber, Wahl 2022), as most trepanations were performed by scraping, the safest procedure for the dura mater.

The healing process of trepanation openings is relatively long. In general, the healing process of cranial injuries is much slower than that of the postcranial bones. The formation of bone callus is practically non-existent on the bones of the vault, with regeneration primarily occurring due to connective tissue (Lauche 1975; Fischer 1970, S. 411). The velocity of this process depends primarily on the integrity of the dura mater (its damaging or fusion to the pericranium considerably inhibits the healing process), as well as on the injured person's age (Fischer 1970, S. 411, 415). If the edges of the hole do not show signs of healing that are visible to the naked eye, this indicates that the person either died during the operation or survived for no more than 3—4 weeks afterward (Fischer 1970, S. 419; Nerlich et al. 2003; Weber, Wahl 2022, S. 522).

The superficial operations mentioned by D. Ortner and W. Putschar often refer to incomplete or symbolic trepanations in anthropological literature. The distinction between these two categories is predicated on the purpose of the operation, which, regrettably, is almost impossible to ascertain. Symbolic trepanations have been observed to be associated with specific rituals (Bereczki et al. 2013). They may be linked to initiation processes («superficial scarring»; Медникова 2001). One example is the «T-sincipital» — a scraped or cauterized furrow along the coronal and sagittal sutures in the shape of the letter T (Manouvrier 1895; Wölfel 1925). Ritual trepanations usually have a certain population pattern, such as a specific location on the skull, multiple cases concentrated in a limited geographic area. On the other hand, therapeutic trepanations performed by a single «surgeon» or surgeon generation (school or tradition) will also have a similar pattern.

Incomplete trepanations are the result of interruption to the process due to various objective or subjective reasons, including the death of the patient. Such injuries are similar to trepanation, and it can be assumed that the process should have been completed by penetration through the inner plate (Ushkova, Kozak 2024, case from the Bilolissia burial of Yamna culture). Conversely, it is important to note that surgical interventions did not necessarily entail penetrating the cranial cavity. Such operations include cauterization, the removal of deep abscesses that penetrate the surface plate of the bone, the cleaning of complicated injuries, and diagnosis.

Signs of injury treatment can be particularly challenging to discern in cases of healed defects. Consequently, it is imperative to identify cases of partially unhealed or incompletely healed trauma with indications of surgical intervention. A notable illustration of this can be observed in the skull of a female from Holovkivka (Ushkova, Kozak 2024) or a Neolithic skull from Italy (Zemour 2019), both of which demonstrate attempts at treatment or remediation of perimortem injuries to the left temporal bone. However, such cases remain infrequent in the published literature.

Materials. In 1977, the archaeological expedition led by Mykola Bondar excavated the barrows in the area of the construction of the Nikopol irrigation system in the Dnipropetrovsk region (fig. 1). Barrow 4 was discovered at a distance of 1.5 km North-East of Novoivanivka village in a flat field surrounded by forest belts and unpaved routes. The mound was ploughed up annually and by the time of excavation was 0.63 m heigh and 30 m in diameter. Ancient horizon was recorded at a depth of 0.58 m, with the thickness of the chernozem reaching 0.35 m. Virgin soil laid at a depth of 0.93 m (Антоненко и др. 1978; Бондарь и др. 1978).

The barrow was erected at once during the Bronze Age and contained six burials. The mound was constructed over the primary Yamna grave. All other graves were identified as inserted burials, with two graves identified as the Yamna culture, two — to the Catacomb culture, and one — to the Zrubna culture.

The subject of this paper is the skull from grave 4. The catacomb was located in the southwestern sector of the barrow (fig. 2). The entrance pit was almost circular in plan, with steep walls and a flat floor. The burial chamber, oriented with its long axis from Southwest to Northeast, was located on

Fig. 1. Kurgans of the s. Novoivanivka on the map of the Northern Pontic region

Рис. 1. Кургани Новоіванівки на карті Північного Причорномор'я

the northeastern side of the entrance pit and has a rectangular form with rounded corners. The bottom part of the chamber was cut into the virgin soil; no vault was visible in the black soil. The wall on the side of the entrance pit was straight, while the other walls had slopes. The dimensions of the entrance pit were 1.24 × 1.05 m, while the burial chamber measured 2.14 × 1.5 × 1.38 m (Антоненко и др. 1978; Бондарь и др. 1978). The fox burrows have significantly damaged the grave.

The skeleton was poorly preserved, only a few small bone fragments, phalanges, and a skull survived. The skull was found lying with its parietal part down in the backfill of the northeastern corner of the chamber. No grave goods were found in the chamber (Антоненко и др. 1978; Бондарь и др. 1978).

The human skeletal remains have not been examined anthropologically until now. The skull, which had sustained postmortem damage (fig. 3), lower jaw, and a coracoid process of the scapula, was stored in the collections of the Archaeological Museum of Taras Shevchenko National University of Kyiv (AM KNUTS).

The bones of pale caramel yellowish color were relatively dense, though the bone tissue along

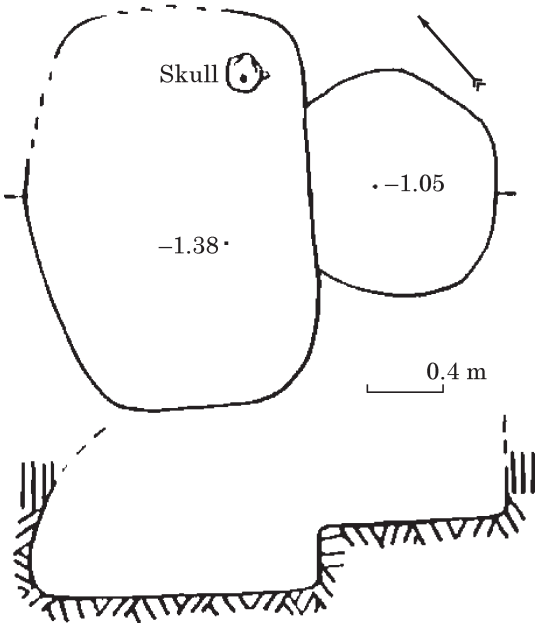

Fig. 2. Kurgan 4, grave 4 of Novoivanivka, plan and cross section (Antonenko et al. 1978)

Рис. 2. План та розріз поховання 4 кургану 4 (Антоненко и др. 1978)

the postmortal broken edges was crumbled. The surface of the bones, as well as the enamel of the teeth, was preserved by more than two-thirds, which made it possible to examine them using paleopathological methods.

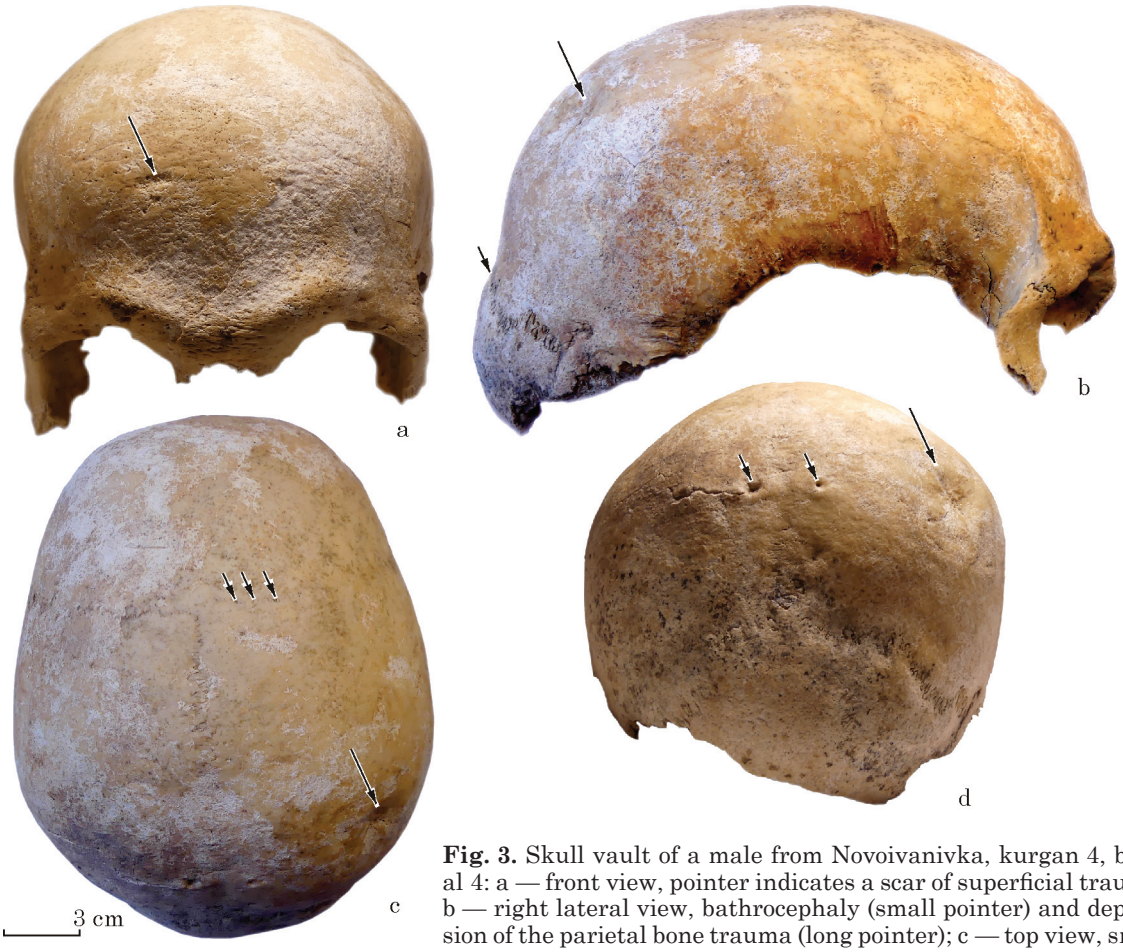

Fig. 3. Skull vault of a male from Novoivanivka, kurgan 4, burial 4: a — front view, pointer indicates a scar of superficial trauma; b — right lateral view, bathrocephaly (small pointer) and depression of the parietal bone trauma (long pointer); c — top view, small pointers indicate a closed area of the coronal suture, long pointer indicates trauma to the parietal bone, asymmetry of the skull is also noticeable; d — view of the skull from behind, small pointers indicate foramina parietale, large pointer indicates trauma

Рис. 3. Склепіння черепа чоловіка з Новоіванівки, курган 4, поховання 4: a — вигляд спереду, стрілкою позначений рубець поверхневої травми; b — вигляд справа, батроцефалія (мала стрілка) та заглиблення травми тім'яної кістки (довга стрілка); c — вигляд зверху, малі стрілки позначають закриту ділянку вінцевого шва, довга стрілка вказує на травму тім'яної кістки, помітна також асиметрія черепа; d — вигляд черепа ззаду, малі стрілки позначають тім'яні отвори, велика — травму

Skull morphology and pathology. The morphology of the skull is indicative of the male sex (fig. 3: a, b). Massive muscle relief can be seen on the occipital, temporal, and mandible bones.

Examination of the exterior surface of the vault reveals remnants of the sagittal, lambda and left coronal sutures (fig. 3: c, d). The right side of the coronal suture is completely obliterated. From the internal lamina, all sutures are closed, except the central portion of the sagittal suture. The pronounced bathrocephaly (fig. 3: b, d) is evidently associated with big suture bones in the lambda suture and with the potential early closure of a suture segment. Observed asymmetry of the occipital bone could also be related to this phenomenon. According to the state of suture obliteration (Vallois 1937), the person's age is estimated between 40 and 50 years. The stage of age-related atrophy of the alveolar margin in the area of preserved teeth indicates an age of 30 or more years. Most of the teeth in the upper jaw, except for the canine and third molar, were lost during life (antemortem). The alveoli of the molars and premolars are completely obliterated. The alveoli of the incisors stand in an active healing process. The wear of the occlusal surface of mandibular molars corresponds to age 35—45 years (Brothwell 1981). However, given the absence of antagonist teeth and the state of obliteration of their alveoli, the age of the male on this indicator could be estimated as 45—50 years.

The general morphology of the skull falls within the range of variations identified for the late catacomb culture populations of the region (Круц 1997).

Among the pathological features, we can mention porosity on the supraorbital ridge, possibly related to chronic inflammation of the paranasal (frontal and maxillary) sinuses. The outer plate of the skull vault bones is thickened and porous. The inner lamina of the skull bones shows deepened imprints of large and small blood vessels, uneven surface and thickening, and traces of proliferative bone reaction in the sulcus of the sagittal sinus.

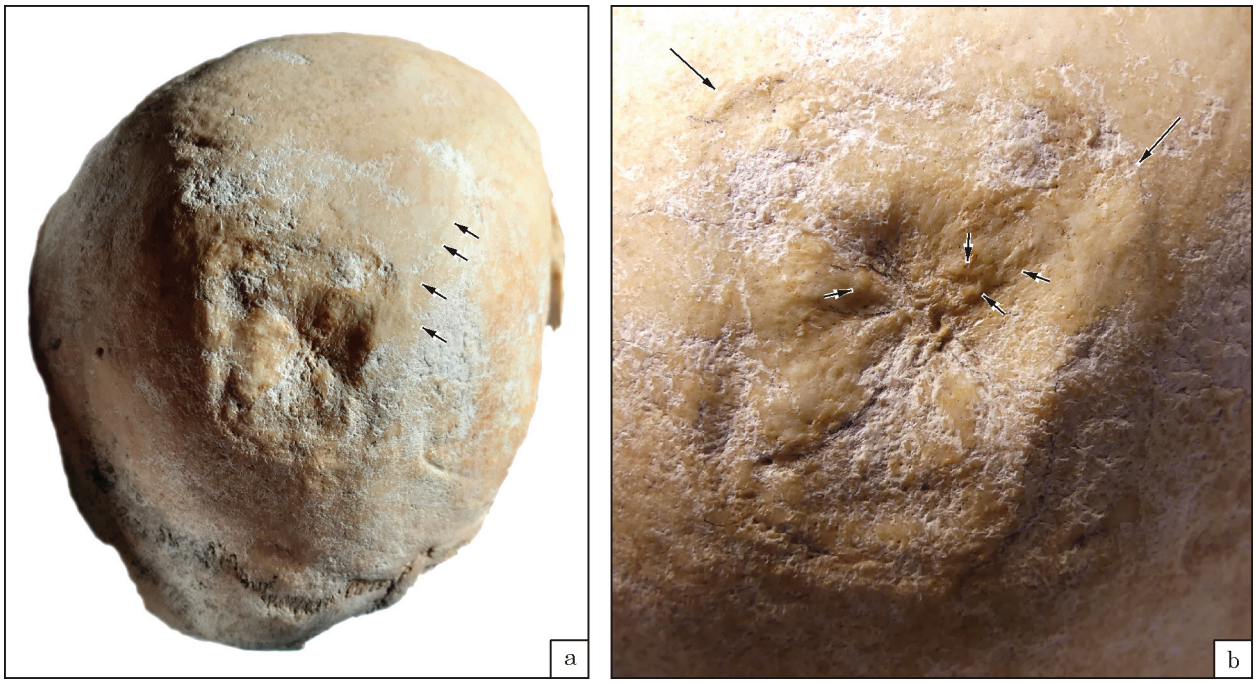

Fig. 4. Trauma to the right parietal bone with signs of surgical intervention: a — general view, pointers indicate the temporal line (*Linea temporalis*); b — area of injury, long pointers indicate the places of rounding of the groove, short pointers indicate traces of proliferative reaction in the epicenter of the trauma

Рис. 4. Травма правої тім'яної кістки зі слідами оперативного втручання: a — загальний вигляд правої тім'яної кістки, стрілки вказують на скроневу лінію (*Linea temporalis*); b — область травми, довгі стрілки вказують на місця заокруглення борозни, короткі стрілки позначають сліди проліферативної реакції у епіцентрі травми

The maxillary and mandibular bones demonstrate signs of progressive alveolar margin inflammation with antemortal loss of most teeth. A calculus of advanced development was found on all the teeth presented. Significant occlusal surface wear, secondary dentin formation, enamel margin chipping, and hypercementosis indicate the mechanical stress on the remaining teeth (Wood 1992, p. 26; Nelson 2015).

Two blunt force traumas on the skull situated on the right frontal and right parietal bone.

Traumas. The superficial trauma is located on the right frontal bone below the frontal tubercle (fig. 3: a). The crescent-shaped injury, curved towards the coronal suture, measured 11 × 6 mm, is slightly deepened into the bone surface in its posterior (upper) part. There are signs of inflammation (thickening and porosity) of the surface around the lesion.

Another depression (20 × 22 mm) is identified in the region posterior and lateral to the right parietal tubercle. The centre of the lesion locates at a distance of 86 mm from the coronal suture, 53.5 mm from the sagittal suture, and 49 mm from the lambda suture; it is deepened into the surface plate, with X-shaped furrows converging towards it (fig. 4: a). The surface between the furrows is thickened, uneven and nodular due to healed bone reaction (fig. 4: b).

A shallow groove (1—2 mm deep) with uneven floor is visible around the depression. The general cross-section of the groove resembles a flattened arc (U-shaped), with a V-shaped configuration in its narrowest regions. Its width is 9 mm anteriorly (frontal aspect), 5 mm posteriorly (occipital aspect), 9 mm medially, and 5—12 mm laterally. The external groove line laterally runs along the temporal line. The surface of the groove is uneven; the parts of it are smooth and deepened, and the others are rough due to bone reaction. Some areas are damaged postmortem.

The general form of the lesion is semi-rectangular. Rounded shallow depressions with a diameter of approximately 12 mm are barely visible in the frontal corners of the lesion. The sagittal diameter of the entire defect along the outer contours is measured at 43 mm, while the transverse diameter is recorded as 37 mm. The medial corners are positioned at a distance of 34 mm (frontal) and 37 mm (occipital) from the sagittal suture, while the occipital corners (posterior) are positioned at a distance of 29 mm and 39 mm from the lambda suture.

The inner table of the right parietal bone exhibits no traces of trauma (fig. 5: a). An interrupted vascular pattern was identified at the site of the external depression (fig. 5: b), suggesting the presence of a healed old hemorrhage due to vascular injury and a small fissure of the internal lamina caused by the impact.

The entire lesion has healed completely. We did not have the opportunity to take an x-ray, but by

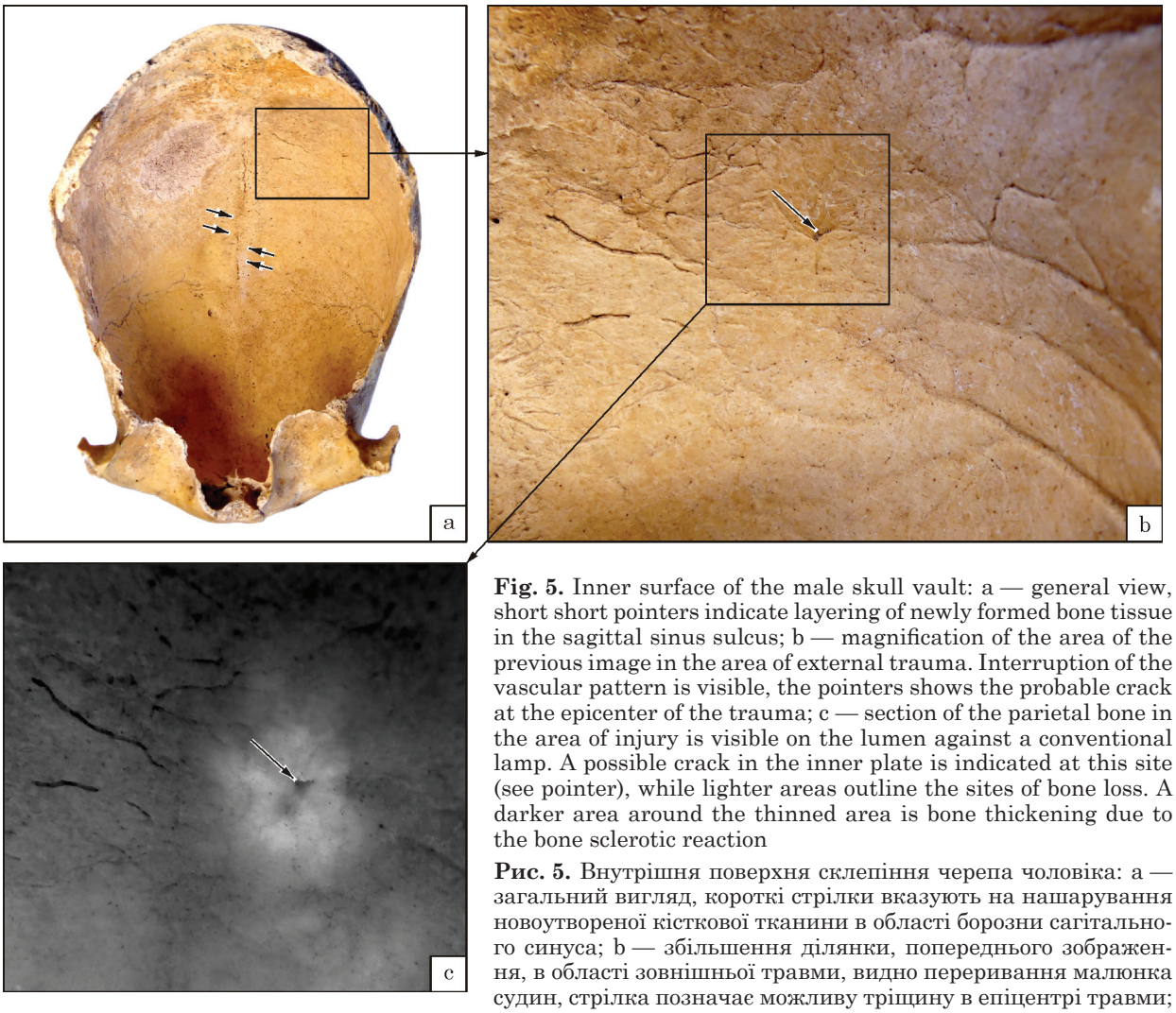

Fig. 5. Inner surface of the male skull vault: a — general view, short short pointers indicate layering of newly formed bone tissue in the sagittal sinus sulcus; b — magnification of the area of the previous image in the area of external trauma. Interruption of the vascular pattern is visible, the pointers shows the probable crack at the epicenter of the trauma; c — section of the parietal bone in the area of injury is visible on the lumen against a conventional lamp. A possible crack in the inner plate is indicated at this site (see pointer), while lighter areas outline the sites of bone loss. A darker area around the thinned area is bone thickening due to the bone sclerotic reaction

Рис. 5. Внутрішня поверхня склепіння черепа чоловіка: а — загальний вигляд, короткі стрілки вказують на нашарування новоутвореної кісткової тканини в області борозни сагітального синуса; b — збільшення ділянки, попереднього зображення, в області зовнішньої травми, видно переривання малюнка судин, стрілка позначає можливу тріщину в епіцентрі травми; с — ділянка тім'яної кістки в області травми, видима на просвіті проти звичайної лампи: стрілка позначає місце можливої тріщини внутрішньої пластинки, світліші області окреслюють місця втрати кісткової тканини, темніший ареал навколо витонченої ділянки — потовщена внаслідок кісткової реакції кістка

holding the skull vault against the light source, the extensive loss of bone tissue is visible in the center of the lesion, with probable puncture or short crack, which is clearly visible; as the perimeter along the groove shows pronounced sclerosis (fig. 5: c).

Discussion and conclusions. The examination of the skull from Novoivanivka brought up the following questions: first, what is the nature of the posterior injury, and what happened during its healing?

The first trauma observed on the frontal bone of the individual from Novoivanivka is a superficial depressed fracture of the outer table. The impact was directed from the front. The shape and depth of the depression corresponds to some non-invasive objects, such as a stone or wooden stick, with a low impact force. The injury was healed without intrusion.

Even a brief examination of the posterior defect revealed its traumatic nature. The size of the depression is comparable to the size of injuries found on the skulls from the area of the Catacomb culture (Круц 1984; Ушкова, Козак 2014). It can be assumed that the individual sustained a blow from right behind by a blunt instrument such as mace or axe (Круц 1984; Schultz 1991; Klochko 2001; Ушкова, Козак 2011; 2014; Козак 2019).

The injury was diagnosed as a depressed incomplete skull fracture with minimal involvement of the inner plate. There is no evidence of its deflection or obvious traces of destruction. However, the signs of proliferative processes in the projection of the external damage, as well as a short fissure in the center of the trauma, suggested that the impact may have caused minimal cracking of the internal plate and damage to the vascular structures of the dura mater. (Wullstein, Wilms 1913, c. 76). According to H. Fischer, such fractures are uncommon and typically occur in areas of the skull that are relatively thick (Fischer 1970, S. 353). The site of such cranial depression injury has been observed to regenerate due to connective tissue, which very slowly turns into bone (Fischer 1970). Pericranium could form only a slight callus. In the absence of complications, the healing process can take several months to

several years. (Fischer 1970, p. 413, 415, 419; Nerlich et al. 2003; Barbian, Sledzik 2008). Various factors, including the age and the health status of the individual influence the process of healing. Evidently, the state of healing of the injury indicates that the individual from Novoivanivka must have been quite young at the time of the injury and surgery.

Despite the incomplete nature of the parietal fracture, the injury led to a pronounced bone reaction, which usually accompanies an advanced inflammatory process.

In case of open head injuries, skin, hair, and dirt particles may become embedded with the broken particles of the outer bone plate. This results in infection of the injury site. The inflammatory process can spread not only to the area of the injury but also to the entire surface of the vault. In some cases, the inflammation can penetrate the dura with the bloodstream and cause osteomyelitis of the skull.

The inflammatory process can result in scarring over the external bone surface, as was observed in Novoivanivka case. We assume that the proliferative process due to inflammation, as well as slight deformation of the skull sutures from the impact, could have caused early closure of the coronal suture on the side of the injury. If it happens during the period of active growth of the brain, in the youth of an individual, it can contribute to moderate skull deformation. However, the possibility of congenital disorders affecting suture closure rates cannot be discounted.

Bone loss in the area of the impression may be explained by the removal of necrotic tissue during surgery, while the proliferative reaction manifests as a result of the intensive inflammation and healing process.

It is implausible that the injury itself or the healing process could have resulted in the appearance of a sulcus around the impression. Its uniformity and structure indicate the artificial origin.

Given the familiarity of the Catacomb culture people with the fundamentals of surgery, as evidenced by the significant number of skull trepanations found in the territory of this culture (Ushkova, Kozak 2024), it is reasonable to suggest that the injury was treated.

The technique of the surgery. The sulcus around the site of the trauma is superficial and forms a rectangle. The sulcus is the thinnest at the posterior part of the lateral aspect of the lesion, close to the temporal line (*Linea temporalis*) of the muscle attachment.

Hippocrates (Hippocrates 1999) and Avicena (Абу Али ибн Сино 2003, с. 180) described the general procedure of the operations for the skull trauma treatment (trepanation). The procedure entailed incisions and the elevation of the aponeurosis flap, thus exposing the pericranium and underlying bone before the surgery. Evidence of this technique has been observed in various skulls since the Neolithic, in cases of unhealed lesions (Ushkova, Kozak 2024). In the case of Novoivanivka, it is conceivable that the flap was thrown along the lateral side of the injury, thereby preventing the surgeon from operating on this side. Consequently, the sulcus is observed laterally to the trauma only at the most distal section from the *Linea temporalis*.

The arcuate cross-section of the groove indicates that it was either scraped or hollowed out with a relatively narrow tool, such as a rounded small scraper or, less probably, a chisel. Rounded depressions at the corners of the groove are likely to be the pivot points of a cutter. These depressions may also indicate drilling holes with a tool possessing a rounded, blunt end [1].

One of the techniques possibly employed in the case of Novoivanivka is comparable with the trepanation made by cutting the square — the process of incising yields a V-shaped groove in the cross-section, with a wider outer edge. The width of this groove is contingent on the thickness and configuration of the used instrument. Typically, square trepanation openings are formed through the intersection of four distinct grooves at right angles (Kirkup 2003, p. 291; Lisowski 1967; Kurin 2013; Erdal, Erdal 2011).

However, in the case of Novoivanivka, the grooves exhibit variability in width, and the rectangle features smoothed corners. The traces of the cutter cannot be observed due to the strong remodeling of the surface. It is worth noting that the method has not yet been identified in the North Pontic region during any of the periods.

The rounded depressions observed at the corners of the quadrangular sulcus may be attributable to drilling holes in these locations. The depressions are superficial, it can be assumed that the drilling, if this took place, did not last long and was carried out with flint (Orłowska 2015). The aims of this drilling remain ambiguous.

Another technique that could have been applied in Novoivanivka skull is furrowing with a chisel. This method is documented in Eastern and Central Europe during the Middle Ages (Kis et al. 2022). Using a chisel may explain the observed irregularity of the sulcus floor (other than the healing process).

The most prevalent form of trepanning or skull surgery during ancient times was scraping, which can exhibit multiple variations. Notably, in the Neolithic period of Germany, G. Ullrich identifies the scraping of ring zones (Ringzoneschabetechnik). This method entailed the gradual reduction in the diameter of the area, leading to the eventual removal of the innermost portion of the bone, known as the «island» at subsequent stages (Ullrich 1971; Weber, Wahl 2022, S. 253). J. Weber and J. Wahl

1. We would like to express our gratitude to Prof. Michael Schultz (Medical University of Göttingen) for highly valuable remarks to the diagnosis of this case.

posited that this technique might have been used for symbolic or incomplete trephinations.

This technique could be applied to the trauma surgery of an individual from Novoivanivka. However, in this case, the scraping was not in a circular pattern, but in relatively straight sections, which may indicate a specific location of the injury on the skull. Rounded depressions in the corners of the rectangular mark the points at which the incisor (scraper) turned.

The grooves are superficial and characterized by uneven width and depth. Still, they do not penetrate the outer lamina of the bone by more than 2 mm. Given the presumably advanced stage of surface healing and the absence of any small tool marks, it can be assumed that the groove was slightly deeper than that immediately after the operation. In any case, the scraping did not reach the diploe.

Objective. The location of the sulcus around the traumatic depression suggests that the therapeutic purpose of the operation was most likely. The surgical intervention was undertaken to address the injury or its consequences.

However, what was the task of the ancient surgeon? We can hypothesize on several potential options: interrupted trepanation, removal of necrotic bone that may have formed around the wound due to infection, elimination of concentric cracks resulting from impact and diagnosis.

Given the condition of the injury surface, it can be assumed that the impact shattered the outer lamina, reaching the diploe. Furthermore, in a living individual, the impact site is typically well-covered with hair. The presence of reaction traces across the entire surface of the skull indicates the potential entry of hair, skin, and dirt into the open wound, which could have led to infection. In the absence of immediate treatment, the infection could have led to an inflammatory response and subsequent tissue necrosis within 1—2 weeks (Barbian, Sledzik 2008). Consequently, the primary focus of the «surgeon» would have been to cleanse the injury.

Conversely, the blow could have resulted in concentric superficial cracks, and in such cases, the surgeon's role may entail diagnosing the depth of the cracks or removing them. The process of such treatment is comprehensively delineated in Avicenna's Canon of Medicine, which cites Galen and the «ancients» (Абу Али ибн Сино 2003, с. 184). Hippocrates described the same procedure in his work «On Wounds in the Head» (Hippocrates 1999, p. 33—37). It cannot be ruled out that the «surgeons» of the Catacomb culture could have developed such experience empirically.

The inflammatory process resulting from infection may lead to sequestration due to osteomyelitis. It can provoke new bone formation (periostitis) due to the proliferative reaction of pericranium (Barbian, Sledzik 2008). This could lead to a faster healing of the injury compared to a sterile wound. This phenomenon can be attributed to the sclerosis observed around the impaction site and in the sulcus area.

The survival of the male individual from Novoivanivka to the age of 45—50 was a remarkable outcome, given that this exceeded the lifespan of 62 % of the Middle Bronze Age population (Круц 1984, с. 24).

The tradition of cranial surgery in the Northern Pontic region could be either autochthonous, i. e. developed independently in these territories, or introduced by other cultures. Evidence of European Neolithic «schools» of trepanation has been identified in France, Britain, the Iberian Peninsula, and Germany. According to S. Piggott, the dissemination of knowledge in cranial surgery could have been brought to Europe and further east by the tribes of megalithic grave cultures (Piggott 1940).

While researching the cranial sample from the Mesolithic Vasylivka III cemetery, I. I. Gohman suggested that the perforation observed on the left parietal bone of the male from burial 31 might be of an artificial nature. The researcher proposed two hypotheses for the origin of the aforementioned perforation: firstly, a healed arrow wound, and secondly, «artificial trepanation» (Гохман 1966, с. 25). D. G. Rokhlin identified healed cranial trepanation on the left frontal bone of a male individual from burial 10 of the Neolithic cemetery Vasylivka II (Гохман 1966, с. 99). Another similar case was documented by I. I. Gohman in the Vovnigy cemetery. The round defect with the diameter of 14 cm was situated directly on the sagittal suture (Гохман 1966, с. 141). J. V. Verano proposed a differential diagnosis for this case, namely meningocele, for its perfectly round shape, localization, and the characteristics of its walls (Verano 2016, p. 23). All three cases with similar forms and dimensions though different locations on the skull vault could also be interpreted as the wound cleaning results after removing the arrowheads or other penetrating objects.

The practice of cranial surgery among the population of Trypillian culture (Lilli et al. 2015; Потехіна 2018) remains uncertain [2].

2. On the right parietal bone of the skull 3 dated to 3709—3537 cal BC (Lilli et al. 2015, p. 58) from Verteba cave in Western Ukraine the 8-shaped hole with sharp edges was discovered. The walls of the opening are vertical and show «saw» marks. The authors of the study did not reject the possibility of these marks to be result of rodent gnawing (Lilli et al. 2015, p. 58). M. Lilli and co-authors hypothesized that the opening was produced either perimortem or postmortem in the process of the skull preparation for burial or for amulet («trophy») producing (Lilli et al. 2015, p. 59). Another explanation for the origin of this opening (surgical intervention for healing the other perimortal trauma) the authors themselves considered illogical. (Lilli et al. 2016, p. 59). Most of the other skulls from Verteba Cave have extended traces of perimortal violence and probable postmortal processing (Kadrow, Pokutna 2016; Потехіна 2018).

Evidence of trepanation has been found in the Early Bronze Age (Yamna culture) in southern Ukraine, suggesting the presence of surgical skills among the practitioners (Ushkova, Kozak 2024). A similar observation was made in the Podillia region of Ukraine, where a healed trepanation was identified on the skull of an individual from the Globular Amphora culture (Козак 2024). These cases are isolated.

In contrast, the mass trepanations observed in the Middle Bronze Age exhibit a greater variety of techniques and methods. In certain instances, the artisans (i. e. surgeons) employed diverse methods, seemingly experimenting with different techniques to identify the most effective approach. The presence of unhealed trepanations in conjunction with evidence of surgical interventions employed to treat cranial wounds, provides a substantial source of material for the analysis of the process of such surgical procedures. Intriguingly, this phenomenon, evident in the unhealed cases, mirrors the descriptions of wound treatment procedures documented in the classical works of Hippocrates and Avicenna.

The case study of surgical intervention for treating a cranial injury on the skull from Catacomb culture burial near Novoivanivka is one of the few published that show the stages and possible variants of the trepanation process as a medical procedure.

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CASE STUDY OF THE SKULL TRAUMA TREATMENT IN INHUL CATACOMB CULTURE BURIAL

The development of cranial surgery began in Europe in the Neolithic period. The main Type of cranial surgery, associated with medical indications or rituals is trepanation which is the removal of part of the bone up to the formation of a hole in the skull vault. The reasons for the first medical operations on the skull include trauma and its consequences.

The present paper is a report of a case of skull injury with traces of surgical intervention.

On the right parietal bone of a man of 45—50 years of age from a Catacomb culture burial near Novoivanivka village, Nikopol district, Dnipro region, a rounded depressed non-penetrating healed injury inflicted by a blunt weapon such as an axe was found. The outer plate of the bone and apparently the diploe were damaged. On the inner surface of the parietal, in the projection of the injury, there was an interruption in the pattern of vascular imprints, which may indicate a well-healed haematoma. This haemorrhage may have been caused by trauma to the dura mater vessels and / or microcracks in the internal lamina.

The quadrangular superficial groove was traced around the injury.

The loss of bone tissue in the centre of the wound and the reactive formations found on its surface may indicate necrosis and inflammation of the bone. The groove around the wound is artificial and has probably been made to clean the necrotic wound edges or to expose and remove concentric fissures around the depression. The entire wound has very well healed, so we cannot see any traces of the instrument used to perform the operation. However, it could be assumed

to be a relatively narrow scraper or chisel-like instrument.

This case is one clear example of surgery to treat a cranial injury. Surgical traces are difficult to distinguish from an untreated injury. Currently, there is no algorithm available to help distinguish between the two. For methodological reasons, we believe it is necessary to publish as many cases as possible of traumas and trepanations that may have been treated at different stages of healing. This will facilitate the study of the development of ancient surgical techniques.

Keywords: cranial surgery, Middle Bronze Age, Northern Pontic region, Inhul catacomb culture.

О. Козак, К. Шарапова

ВИПАДОК ЛІКУВАННЯ ТРАВМИ ЧЕРЕПА З ПОХОВАННЯ ІНГУЛЬСЬКОЇ КАТАКОМБНОЇ КУЛЬТУРИ

Черепна хірургія почала свій розвиток за доби неоліту на території Європи. Основним типом операцій на черепі, пов'язаним з медичними показаннями або ритуалами, є трепанація — видалення частини кістки аж до утворення отвору. Причинами перших медичних операцій на черепі, серед іншого, вважають травми та їх наслідки.

Представлена стаття присвячена випадку поранення черепа за слідами хірургічного втручання. На правій тім'яній кістці чоловіка 45—50 років з поховання катакомбної культури біля с. Новоіванівка, Нікопольского р-ну Дніпропетровської обл., було виявлено округлу вдавлену непроникаючу травму, нанесену тупою зброєю типу сокири. Пошкоджена зовнішня пластинка та, очевидно, диплое. На внутрішній поверхні кістки в проекції травми виявлено переривання малюнка відбитків судин, що може свідчити про добре загоєну гематому. Крововилив між бути спричинений травмою судин твердої оболонки мозку та / або мікротріщинами внутрішньої пластинки. Зовні навколо травми наявна чотирикутна поверхнева борозна. В місці травми виявлено значну втрату кісткової тканини, в області борозни — її потовщення (склероз). Втрата кісткової тканини всередині рани, а також реактивні утворення, які виявлені на її поверхні, можуть свідчити про запалення та некроз кістки. Борозна навколо рани має штучне походження й, за нашим припущенням, зроблена для очистки некротизованих країв рани або видалення концентричних тріщин навколо вдавлення.

Вся рана дуже добре загоєна, таким чином, ми не можемо виявити слідів інструмента, яким було зроблено операцію. Однак можна припустити, що було застосовано відносно вузький скребок або інструмент типу долота.

Цей випадок є одним із прикладів операції, які проводилися для лікування травми черепа. Сліди хірургічних операцій досить важко диференціювати з травмою, загоєною без втручання. Наразі недостатньо розроблений алгоритм такої диференціації. Для методичних наробок ми вважаємо за необхідне публікацію якомога більшої кількості випадків можливих пролікованих травм та трепанацій у різних стадіях загоєння. Це сприятиме дослідженню процесу розвитку хірургічних технік.

Ключові слова: черепна хірургія, доба середньої бронзи, Північне Причорномор'я, Інгульська катакомбна культура.

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