The Siberian Lancet: One More Possible Innovative Example of Scalpel's Contribution to the Evolution of Surgical Anatomy and Neurosurgery

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BACKGROUND: **Several primitive scalpels were used since the eve of surgical procedures. Numerous bronze knifes discovered in the Altai mountains region from the Xiongnu-Xianbei-Rouran period mold a hypotheses for a possible medical use.**

METHODS: **On-sight archaeologic excavation brought into light the tools in question.**

RESULTS: **Knifes, similar to modern lancets, were unearthed alongside with a series of skulls demonstrating signs of trepanation.**

CONCLUSIONS: **Strong indications imply that those cutting tools, except for domestic usage, were one more example of scalpel's contribution to the evolution of surgical anatomy and neurosurgery.**

INTRODUCTION

Since the first steps in the evolution of surgery, the only possible available way to visualize human body's visceral anatomy for a practitioner was through trauma. Its understanding was founded from direct observation of those wounds. The more severe they were, the best for the practitioners to observe, note, and understand. Soon it was made clear that to gain access and vision for a surgical intervention or the removal of foreign bodies, those traumatic wounds needed to be extended through cutting of the skin barrier. The accurate incisions required an instrument with the appropriate ability for cutting with precision. This cutting tool most probably arose from domestic knives, whose blades were manufactured with various materials depending on the era of its development. Bones, ivory, animal shells or teeth, and stone were used before the introduction of metal elements.[1] The first surgeons gained experience primarily in the battlefields of antiquity.[2] The same happened to the nomadic tribes of the Asiatic origin, who were known for their furious warriors and were among the first who mastered the warfare. In their ranks, battle surgeons and practitioners treated the wounded or the diseased.[3] It seems that this was a common practice, since the era of the Scythian tribes, who knew a lot on bone traumas and battle wounds (**Figure 1**).[4,5] Moreover, magico-therapeutic, or magico-ritual, motives made the Scythians experienced in skull trepanation, which was made either in living patients or postmortem for learning and observation (**Figure 2**).[6,7] Since the beginning of the 2nd century BC, all of Southern Siberia territory underwent significant cultural transformations, mostly because of political factors. The most important one being the rise of a mighty empire of Xiongnu nomads in Mongolia and Transbaikal, causing the transformation of the Scythian-type nomads in Southern Siberia, and in particular in the Upper Altai, into a Hunnic model of culture.[8] However, the experience on treating battle wounds and the spirit with the trephine procedure endured.

IRON KNIVES AND THE TREPANATION PROCEDURE

In a settlement of the Xiongnu-Xianbei-Rouran period, the Chultukov Log in Northern Altai, which was the northwestern periphery of the nomadic kingdoms of the empire, a series of iron knives were discovered both in houses ruins and tombs. The knives were probably used in the local bone processing workshop for the manufacturing of a plethora of bone tools which were found in the area. Moreover, some were used for skull trephine as was confirmed after thorough study with mass spectral analysis and x-ray fluorescence studies. Both the skull bone samples and the metallic tools found in the same tombs were analyzed. The suitability of such knives for that purpose was obvious among the surgeons of the era.[8] Various cases of trepanated skulls were discovered by archaeologists in the Altai mountains (**Figure 3A**).[7]

The term trepanation describes a surgical intervention when a piece of skull bone of a living individual is removed without any damage to the underlying blood vessels, meninges, and brain as performed in ancient Greek culture since the era of Asclepieia and introduced in medical texts by the Hippocratic School of Medicine.[9] The observed defects of the discovered skulls were clearly artificially handmade and could not have been explained by a bone damaging disease, or an acute trauma causing a fracture (e.g., axe, hammer, sword, rock). The Siberian surgeons carried out trepanation in strict accordance with the recommendations made by the Hippocratic School of Medicine around the 5th century BC. In some cases

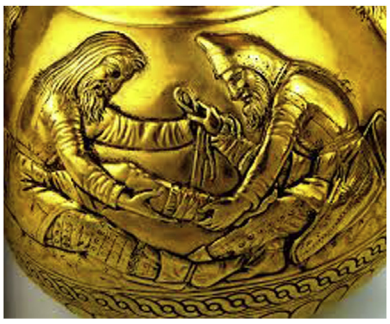

Figure 1. Battle surgeon treating a Scythian warrior, Treasure of Kul-Oba, Ermitage Museum, Saint Petersburg.

however, the ancient Siberian medics used the technique of scraping the bone, an alternation which gave the highest chance of survival during ancient trepanation procedures. Statistics of the prehistoric trepanations indicate that those surgical operations were highly successful, with an overall survival rate from 50% to 90%, with few ensuing complications. This huge success could have been explained by the small diameter of most perforations, made in secure locations so that they did not cross into the superior sagittal sinus and zones of dura mater, which were usually avoided. Therefore, to prevent massive bleeding, Siberian surgeons correctly placed the bone hole more than 1 cm away from the suture at the margin of the sagittal sinus, demonstrating an exceptional knowledge on surgical anatomy.[7] They used flint, iron, copper,

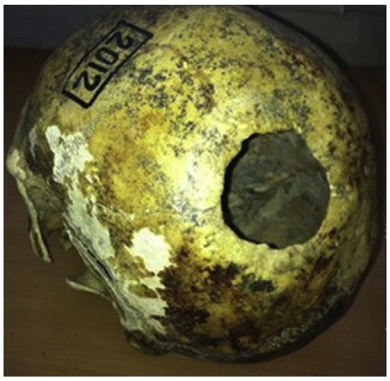

Figure 2. Trepanation in ancient Scythian times (500-300 BC), Krivoshapkin et al.

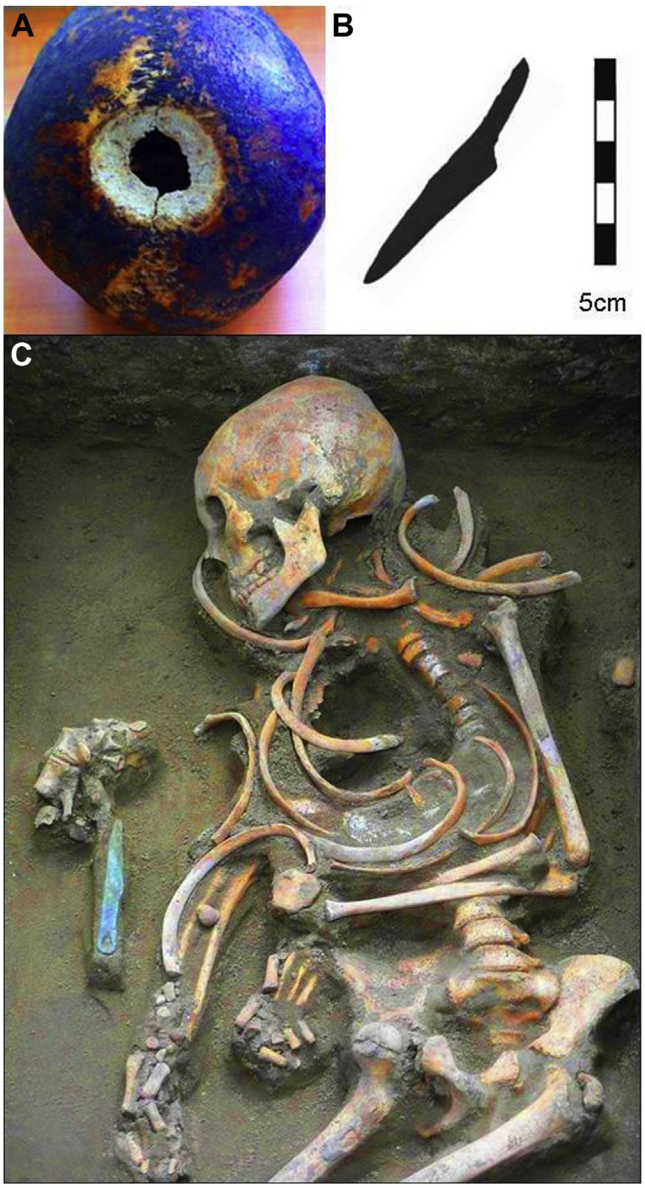

Figure 3. (**A**) Trepanation defect on female skull from tumulus complex Kyzyl-Dzhar-IV, Altai region, Siberia. (**B**) Iron knife found in Chultukov Log 9, "domestic handgrip." (**C**) Bronze knife in a grave on the burial ground Chultukov Log, Altai Mountains. Picture: Andrey Borodovsky, "surgical nose and handgrip."

or bronze tools for trepanations. Hippocrates described various trepana (bone drilling surgical instruments, the trepan, the serrated trepan, the probe, and the raspatory). It seems that for a skilled Siberian surgeon, the use of a universal bronze knife had to be sufficient.[7,9] Whether the procedure was performed because of medical or ritual reasons still remains unclear. It seems that there was a cultural interaction, either through commerce or battle campaigns (Alexander the Great, Scythian mercenaries).[9] The nomadic tribes of Siberia used copper, bronze, or iron tools for both daily activities and medical practice, whereas the ancient Greeks used more precise and specially manufactured and designed medical instruments. The Greeks preferred to use

Figure 4. A Scythian sharpening his knife (myth of Marsyas), Roman marble copy of the original Hellenistic work 200-150 BC, Uffizi Museum, Florence.

a trepanon (Greek: τρέπανον) for the skull drilling, whereas the nomadic tribes of Northern Siberia practiced the bone scraping technique as their gold standard. The skull trepanation performed by both the ancient Greeks and the nomadic tribes, for some researchers, means a simple coincidence of a parallel surgical advancement between 2 different civilizations.[10] The Siberian knives found as funereal artifacts in tombs of commoners may imply that some shepherd-warriors were trained in surgery, while at the same time those knives were vital tools in their daily activities. Various knives presented nonmetallic handgrips (wooden, bony, ivory) (**Figure 3B**), whereas others had a more solid metallic handle and more sophisticated cutting edges (**Figure 3C**).

DISCUSSION

Whether the knives found in tombs were used only for dissections and surgical procedures such as trepanation is uncertain. It seems that they had a domestic use too because a plethora was found in houses of the commoners of the era. Bone products manufacture and agricultural tasks should have been implied.[8] Furthermore, apart from the swords and daggers found in Scythian tombs, various knives were in place too, seemingly for general use rather than weapons. For some researchers, the Scythian knife was a significant part of a nomad's domestic gear (**Figure 4**).[11] Iron knives were discovered among other findings (e.g., clay whorls, bronze rattles, bronze phaleras, pottery, bone tools) in Scythian tombs both in the Carpathian basin and in the Altai mountains, enhancing the theory of its usage in daily activities by the villagers, in rituals by the Samans, and in therapeutics by the practitioners-surgeons.[8,12]

Clinical and surgical anatomy were, in a primitive state, existent in ancient Scythian and Northern Siberia nomadic tribes. Various skeletons and parts of skeletons, in the latter case bones were found in their regular anatomic positions, were discovered in tombs, with signs showing that dissection of bodies took place during that era.[13] The Northern Siberian nomadic tribes demonstrated a high interest toward psychic disorders, and neurosurgery was somehow evolved among them. They tried to cure melancholy with cutting in specific cutaneous areas under the ears to cause copiously biding and prevent madness, whereas for the same reason they had been performing cranial trephination, with samples found in the Altai mountains.[8,14] The procedure of the cranial trepanation, which was described by the Hippocratic medico-philosophers in the *Corpus Hippocraticum*, may have been borrowed by Hippocrates when he traveled to Scythia.[15]

Moreover, their stylish zoomorphic and anthropomorphic style, with their anatomic details depicted in their art artifacts, indicated their inclination toward the knowledge of the body's structure. The ancient sculptors and artists would have a clear knowledge of anatomy to produce such vivid representations of the human body because they knew how to use their anatomic knowledge to develop man's physical potential to fit a certain ideal model for their work. They mostly would have understood the living muscle movements by learning the surface anatomy, but on the other hand they would have been coping with battle wounds too to comprehend surgical anatomy.[3,16,17]

EPILOGUE

The tribes in Northern Altai used knives for various purposes. Domestic tasks, religious rituals, and surgical procedures were all implicated. Surprisingly, the cutting tools presented similarities toward more advanced scalpels, having more than one cutting edge, depicting a primitive surgical lancet. This may have been an original beginning of the evolution of surgical anatomy and neurosurgery, which further paved a global distribution of such a technique through population immigration and the exchanged knowledge during educational wandering of the ancient scholars.

REFERENCES

1. Moutrey S. *The Fundamentals of Surgical Instruments: A practical Guide to Their Recognition, Use and Care*. Shrewsbury, UK: TFM Publishing Limited; 2017.
2. Pollak K. *La Médecine dans l'Antiquité*. Athènes, Greece: Éditions Papadimas; 2007.
3. Grmek M, Gourevitch D. *Les Maladies dans l' Art Antique*. Paris, France: Fayard; 1998.
4. Murphy EM. Iron Age archaeology and trauma from Aymyrlyg, South Siberia. *British Archaeological Reports International Series*. 2003;1152:1-231.
5. Denko CW, Denko JD, Malemud CJ. Artistic evidence of inflammatory arthopathy from ancient Scythia. *Arch Med*. 2016;8:4-7.
6. Arnott R, Finger S, Smith C. *Trepanation*. Lisse, The Netherlands: Swets & Zeitlinger; 2003.
7. Krivoshapkin AL, Chikisheva TA, Zubova AV, Kurbatov VP, Titov AT, Volkov PV. Scythian trepanations in the Gorny Altai in Hippocratic times: modern expert appraisal of ancient surgical technologies. *World Neurosurg*. 2014;82:e649-e655.
8. Oleszczak L, Borodovskiy AP, Michalczewski K, Pokutta DA. Chultukov Log 9. A settlement from the Xiongnu-Xianbei-Rouran period in the Northern Altai. *Eurasian Prehistory*. 2018;14:153-178.
9. Tsoucalas G, Kousoulis AA, Mariolis-Sapsakos T, Sgantzos M. Trepanation practices in Asclepieia: systematizing a neurosurgical innovation. *World Neurosurg*. 2017;103:501-503.
10. Faria MA. Primitive cranial surgery-Scythian trepanations (500-300 BC). *World Neurosurg*. 2015;84:1174.
11. Minns EH. *Scythians and Greeks: A Survey of Ancient History and Archaeology on the North Coast of the Euxine from the Danube to the Caucasus*. Cambridge, UK: Cambridge University Press; 2011.
12. Bakay K. *Scythian Rattles in the Carpathian Basin and Their Eastern Connections*. Budapest, Hungary: Akadémiai Kiadó; 1971.
13. Center for Comparative Studies of Ancient Civilizations. *Ancient Civilizations from Scythia to Siberia*. Vol. 2. Leiden, The Netherlands: Brill; 1995.
14. Burton R. *The Anatomy of Melancholy*. Glasgow, Scotland: Richard Griffin and Company; 1824.
15. Herodotus. *History of Herodotus*. Vol 4. London, UK: John Murray; 1862.

16. Aruz J, Farkas A, Alekseev A, Korolkova E. *The Golden Deer of Eurasia: Scythian and Sarmatian Treasures from the Russian Steppes*. New York, NY: Metropolitan Museum of Art; 2000.

17. Niebhr BG, von Niebhr M. In: . *Lectures on Ancient History: From the Earliest Times to the Taking of Alexandria by Octavianus. Comprising the History of the Asiatic Nations, the Egyptians, Greeks, Macedonians and Carthaginians*. Vol. 1. Philadelphia, PA: Blanchard and Lea; 1852.

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