Winner takes all: reconstructing the decapitation of a warrior in Bronze Age China from osteological evidence

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Abstract

Decapitation is an ancient practice in Asia with inadequate research. The present study reports on the osteological examination of a headless skeleton excavated from a high-status tomb in Chu State style dating back to the late Warring States Period (ca. 3th century BC) in Lu'an, Anhui, China. The individual is identified as a victim of decapitation with five peri-mortem sharp force cut marks on the posterior parts of the cervical vertebrae, and another one on the right second metacarpal. Microscopic observation of the kerfs, the historical records and archaeological evidence support the speculation that the individual could be a warrior of Chu State, who is decapitated after being wounded during the war against the Qin State. The hacking implement and the sequences of the cut marks are further discussed to reconstruct the process of execution. This multidisciplinary reconstruction is the first scientific osteological analysis of the decapitation on the human remains from the Chinese Bronze Age. Moreover, it will enrich our knowledge of the decapitation phenomenon in terms of war and execution in ancient China.

Keywords Decapitation · Peri-mortem cut mark · Tomahawk · Cervical vertebrae · Warring States Period of China

Introduction

Decapitation, in other terms, beheading, is a pervasive worldwide ancient practice which is implemented in different cultural contexts as a cultural phenomenon or social behavior (Aldhouse-Green 2006; Armit 2012; Chacon and Dye 2007; Pearson 2005). Anthropological and historical records have provided several social reasons that may have motivated the ante- or post-mortem head removal in different individual circumstances and cultural contexts (Carty and Gleeson 2013; Harman et al. 1981; Buckberry 2008; Borsje 2007; Boylston et al. 2000; Buckberry and Hadley 2008). By severing the head from the body, decapitation could be a ritual mortuary

practice in order to destroy the soul; a consequence of armed confrontation to kill the foe; a form of trophy to dishonor the dead; a form of sacrifice and a consequence of judicial executions (Philpott 1991; Carty 2015). In order to distinguish and identify the motivation behind the decapitation, it will be an effective way to combine the osteological evidence with the archaeological and historical contexts in which they occur (Carty 2015).

The removal of heads is recognized as early as in the Neolithic period (Simmons et al. 2007; Talalay 2007). In the Levant of the northern Syria, the postmortem decapitation is implemented using stone tools during the early Pre-Pottery Neolithic period, roughly 12,000–10,500 BP as a ritual mortuary practice before the body was totally decomposed (Kanjou et al. 2015). In America, the case study of the earliest mortuary ritualized decapitation could be dated back to cal. 9100–9400 BP which is found in east-central Brazil (Strauss et al. 2015). And in Capsian of Algeria in North Africa, decapitation is also observed dating to cal. 8000 BP, which is attributed to either utilitarian or ritual purposes (Haverkort and Lubell 1999). More recently, decapitation burials have been identified more frequently from the Bronze Age to the early modern period in the Europe (Philpott 1991; Müldner et al. 2011; Bush and Stirland 1991; McKinley 1993; Anderson 2001; Pitts et al. 2002; Carty 2015; Kozakaitė et al. 2018;

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Gardela 2013; Ström 1942; Tucker 2012, 2015; Harman et al. 1981; Armit 2006; Tracy and Massey 2012), the Near East (Dolce 2018), the America (Moser 1973; Lessa 2007; Chacon and Dye 2007; Tung 2008; Conlee 2007; Valdez 2009; Proulx 1971, 1999, 1989; Browne et al. 1993; Verano 2001, 2003), and the Asia (Krohn 1927; Hutton 1928; Gohain 1977; Morimoto 1987; Morimoto and Hirata 1992; Tillema 1989; Phelan 1994; Hoskins 1996; Needham 1976; Nagaoka and Hirata 1992; Lee et al. 2017; Nagaoka et al. 2009) attributed to the interpersonal conflict, cult of the head, and headhunting rite. The portability and importance of a severed head makes it an ideal trophy of war to display one's status, power of heroism, and prowess, harvests, rebirth, and military supremacy, and is considered as a military merit with an honor to be knighted and gifted (Ó Donnabháin 1995, 2011; Goldsworthy 1996; Carty 2015; Ogburn 2007; Proulx 2001; Petersen and Crock 2007; Toyne 2011). Besides, decapitation is frequently employed during the medieval and early modern period in Europe as a form of judicial execution (Waldron 1996).

Decapitation has been recorded in ancient Chinese historical documents for a long time. All types of decapitation have been identified in archeological discoveries (Qian 1994; Sun 1998). During the Neolithic period, ritual skulls are found buried under the foundation of the houses and rampart or in the individual sacrifice pits in Banpo site, Wangchenggang site, Yinjiacheng site, and Shimao site in Shaanxi, Henan, Shandong provinces (Jin 2005; Chen et al. 2016). Besides, headless skeletons are also found in burials in Beishouling site, Liuwan graveyard, Gamatai site, and Dahecun site in Shaanxi, Qinghai, Henan provinces, which could be attributed to sacrifice, conflict, or headhunting rite (Jin 2005; Wang 2015). During the Shang Dynasty in the Bronze Age, thousands of skulls and headless skeletons of young males are found in the sacrifice pits or burials, which are located close to the Kings' tombs in the last capital of the dynasty (Jin 2005; CASS 1977). Notably, the severed skulls are found in the bronze sacrificial vessels as grave goods (Sun 2015). Meanwhile, from the Zhou Dynasty to Ming Dynasty, another type of decapitation is implemented by the victors of the war. The heads of their enemies are collected as trophies to construct a mound named "Jinguan" or the skulls are made into cups to show military achievement and express contempt to the enemies (Zhou 2005; Zhu 2011; Shi 1996; Zhao 1996; Zhao and Wang 2016; Shi and Song 1996). Even till recently, the headhunting rite is still preserved in some ethnic minorities as a sacrificial ritual in Southwest China in Yunnan province (Li 1987; Wang 1994).

In 2011, a high-status tomb dating back to the Bronze Age is scientifically excavated in Lu'an, Anhui province, which is the last capital of the Chu State called "Shou Chun" during the Late Warring States Period in China (Qin 2012). Warring States Period at the late phase of Chinese Bronze Age is a crucial

transformative period as wars and conflicts between different principalities constantly occurred during this period of ancient Chinese history. The well-preserved headless skeleton in this tomb represents one of the most complete and recognizable decapitation cases during that period in China. Although there are abundant archaeological discoveries related to the ancient Chinese decapitation, however, due to the poor preservation and the insufficient awareness in the past, no scientific osteological analysis has ever been conducted regarding the reconstruction of ancient Chinese decapitation. The archaeological excavation of M585 provides a valuable opportunity to look into the phenomenon of ancient execution in China. By analyzing the morphology and direction of the cut marks on the skeleton, the aim of the present study is to speculate the hacking implement and to reconstruct the process of execution, which will contribute to our understanding of the cause of death, the lethal implement, and the process of the decapitation, and further enrich our knowledge of the decapitation phenomenon in terms of war and execution in ancient China.

Materials and methods

Tomb M585 (N 31° 76' 92", E 116° 55' 28") is located on the hummock in the central region of Bailuzhou in Lu'an City of Anhui province (Fig. 1). It is an earthen pit tomb with a path leading to a grave. The structure of the tomb is designed as one outhouse and one chamber with three layers of coffins, which are maintained in good condition. The outhouse is a square chamber which surrounded the inner chamber; the inner chamber is a rectangular space containing the three layers of coffins. The grave goods of the tombs are rich and diverse consisting of bronze, pottery objects, and lacquer wares. Among them, some military implements such as one set of lacquered armor, bronze sword, axe, and other types of weapon are buried along with the burial of M585. The inner coffin is immersed with dark brown liquid, and the human remains immersed in the liquid are found to be in black color distributed haphazardly in the coffin, and the skull is not found inside. The skeleton is in good condition and about 90% of the skeleton is present for examination (Fig. 2).

The skeleton is laid out in anatomical position. The sex and age of the individuals are determined based on skeletal remains utilizing pubic symphysis, cranium, and dental wear (Périer 1949; Smith and Knight 1984; Brooks and Suchey 1990; Buikstra and Ubelaker 1994). The skeletal traumas are examined using various scientific techniques. Macroscopic observation is focused on the anatomical location, shape, and dimensions of the skeleton, and microscopic observation is focused on the morphology and edges of the cut marks,

Fig. 1 The location of the archeological site

attempting to detect the condition of healing, if any. The details of the osteological cut marks on cervical vertebrae and metacarpal are observed and measured by using the high-resolution deep-field microscope (VHX-2000 series, Keyence, Japan).

Results

The individual is identified as a male adult at the age of about 35 to 39 with clear evidence indicating the presence of implied decapitation. Based on the macroscopic observation, the individual of the tomb M585 is headless with five obvious sharp

Fig. 2 The tomb onsite and the human remains of the individual of M585 (phalanges were completely preserved but not laid out)

force cut marks on the cervical vertebrae and another one on the right second metacarpal. These cuts on the vertebrae were mainly located on the posterior parts of the axis, atlas, and the third cervical vertebra. Among the five cut marks, three of them were superficial in a nearly horizontal direction; the other two were much deeper in a direction from right to left inferior-superiorly. The cut marks were neat with no taphonomic damage, periosteal reaction, or healing signs observed, indicating that they were received peri-mortem (Sauer 1998). According to the experimental studies of traumatic morphology (Walker and Long 1977; Greenfield 1999), the microscopic profiles of the cut marks made by metal implements tend to be steep and smooth in V-shaped cross-section with a distinct apex. Microscopic observation of the cut marks revealed the vertically straight kerf wall and combined “V” and “U”-shaped cross-section, indicating the presence of cut marks left behind by large bladed implement in a hacking or chopping motion (Fig. 3). The precise measurements of each cut were listed in Table 1.

The cut marks on the vertebrae are characterized by straight and narrow kerf clustered on the atlas, axis, and the third cervical vertebra. Cut one is a fairly shallow straight kerf located at the superior lamina beneath the right superior articular facet on the third cervical vertebra; cut two is a slightly deeper straight kerf located at the superior lamina of axis on the right; cut three is a long disconnected straight kerf through the anterior surface of the vertebral foramen beneath the odontoid process on the axis, which left two deeper marks on the right and left ends and a relatively shallow mark in the middle. These three kerfs are superficial in depth in a nearly horizontal direction. Another two cut marks differ in angle to those superficial ones and are in a direction from right to left inferior-superiorly. Cut four is at an angle through the superior lamina of the third cervical vertebra and across the inferior part of the spinous process of axis, penetrating 0.65 mm into the vertebral body on the axis and removing the right superior articular facet, the uncinate process of the third cervical vertebra, and part of the spinous process and lamina of axis; cut five truncated the odontoid process from the axis and most part of the atlas, leaving the remaining the flat cut surface with trabecular bone exposed (Figs. 4 and 5). Except for the above ones observed on the cervical vertebrae, another cut mark is observed on the superior surface of the second metacarpal on the right

hand as a defensive wound. It is 5.13 mm in length and 1.16 mm in width. The force is coming from distal and applied on the hand horizontally (Fig. 6).

Discussion

The recognition of identity and decapitation

Decapitation usually results in characteristic damage to the skeleton. Normally, as the execution of decapitation is implemented with the blow struck from back to front, it would produce traumatic lesions affecting the posterior parts of the cervical vertebrae with cut marks. It can be confirmed by observing that one or more cervical vertebrae has been transected or left with cut marks, even sometimes with additional damage to the mandible, the mastoid processes, or the first rib (Waldron 1996). In the present case, five obvious peri-mortem sharp force cut marks were observed on the posterior parts of the axis, atlas, and the third cervical vertebra. Among the five cut marks, three of them were superficial in a nearly horizontal direction, and the other two were much deeper in a direction from right to left inferior-superiorly. Besides, a peri-mortem sharp force trauma is also observed on the metacarpal. The metacarpal is easily damaged in conflict, indicating that this cut mark is received during the war as a defensive trauma before the victim is captured. All these osteological evidence demonstrate that this individual was decapitated soon after he got injured during the war.

The archaeological findings support the speculation that the identity of the individual is a high-ranking warrior of the Chu state (Qin 2012). The tomb is structured in high-status configuration and the abundant grave goods indicating the high social status of the individual. The historical records <Xunzi-Etiquette> indicates that “Ten layers of coffins for the King, five layers of coffins for the marquis, triple layers of coffins for the senior official, and double layers of coffins for the general official.” As to the grave goods, the historic records <Etiquette of Zhou> indicates that “Ding is a privileged sacrificial vessel for the nobles to claim the identity, nine Dings for the King, seven Dings for the marquis, five Dings for the senior official, and three or one Ding for the general official.” The triple-layer coffins of M585 with four

Table 1 Measurements of the cut marks on the cervical vertebrae

	Morphology	Length	Minimum width	Maximum width	Depth
Cut 1	Linear	8.29 mm	/	/	/
Cut 2	Linear	7.93 mm	0.17 mm	0.76 mm	/
Cut 3	Linear	29.84 mm	0.05 mm	0.86 mm	/
Cut 4	Linear and plane	/	0.69 mm	5.35 mm	0.65 mm
Cut 5	Plane	/	/	/	/

Fig. 3 Microscopic observation of the cut marks on the axis by the high-resolution microscope

Dings revealed the senior official identity of the individual. Moreover, several valuable equipments and weapons

including armor, copper sword, and bronze daggers further support the speculation of the identity of warrior (Qin 2012).

Fig. 4 Illustration of the five cut marks on the cervical vertebrae (A posterior view; B superior view; C illustrated in the anatomical model)

Fig. 5 Cut marks on the atlas, axis, and the third cervical vertebra

The location of the tomb and the period also contribute to our recognition of the individual's identity. Lu'an is located within the territory of the last capital of Chu State during the Late Warring States Period, when the Chu State is defeated by the Qin State. The Qin State is a powerful principality with strong military forces during that period. Among the principalities during the Warring States Period, the military reward policy of Qin State is closely related to the decapitation which encouraged the soldier to earn military merit and a promotion by decapitating more enemies (Fu 2008). According to the historical records, the Qin State implemented more than 1.7 million decapitations during the twenty-two wars against the Wei States, Zhao State, and Chu State between 364 and 234 BC (Fu 2008; Wang 1957). Among them, the war with Zhao State occurred in 260 BC resulted in the fall of the

Changping city with four hundred thousand decapitations (Wu 2015). The remains of the war was identified in 1995 in Shanxi province, and one of the mass graves contained 130 skulls of male adult with traumas (Shi 1996). These historical records and archaeological evidence demonstrate the prevalence of decapitation during that period and the individual of M585 is extremely likely the victim during the war between the Chu State and the Qin State.

The speculated weapon used for the decapitation

Normally, decapitation leaves evidence of a cut mark on the bone, indicating that a heavy implement is involved. The osteological evidence and the characteristics of cut marks provide direct clues for the speculation of the implement of

Fig. 6 Cut marks on the second metacarpal on the right hand

execution. Through visual observation, the margins of the five cut marks on the cervical vertebrae were relatively neat and sharp, with no bone breakdown at the edges and a very thin inner diameter, with the thinnest part being only 0.045 mm. It showed that the cutting edge of the implement used is sharp and is wielded in a high velocity. By observing the bronze lance and sword excavated from the Warring States Period, the cutting edge of the lance is too thick to produce a sharp force trauma with such a thin inner diameter; meanwhile, the sword is basically straight in cutting edge, which could not matched with the cut marks observed on the cervical vertebrae. Given the information, a simulated experiment is conducted by using cardboard to simulate the implement used for the execution. The third cut mark is a hack across the axis posterior-anteriorly which is deep on the left and right ends and shallow in the middle. The right side is deeper than the left side, proving that the force applied on the right side is greater than on the left side. The difference between the depths of the cut mark is attributed to the edge shape of the implement. Two small pieces of rectangular and cambered cardboard with a thickness less than 0.02 mm were used to simulate the implement applied on the cut mark separately. The rectangular cardboard straight failed to fit the cut mark but the cambered one did (Fig. 7). When the edge of the cambered cardboard touched the kerf floor of cut mark on the left and right ends, the edge of the middle part just applied on the vertebral body superficially. This explained that the cutting edge of the implement which caused this cut mark is not straight but in a cambered shape so as to form that characteristic of cut mark.

In view of hacking implements being relatively understudied (Humphrey and Hutchinson 2001; Lewis 2008; McCardle and Stojanovski 2018), the speculation of implement should be associated with records regarding the likely weapon used during that period. The continual war during the

Warring States Period contributed to the development of weapon innovation and manufacturing technology. The bronze sword, spear, halberd, axe, tomahawk, and dagger are common hand-held weapons used during the Zhou Dynasty. Among the popular hand-held weapons during that period, the edge shape of the implement, which could have caused the cut marks on the cervical vertebrae, is closest to the edge shape of tomahawk. The shape of the tomahawk is in an axe shape with thin and arc-shaped edge which has been used as either a weapon or implement of execution since the Neolithic period (Yang 2003). The stone tomahawk is found during the Neolithic Age, and the bronze tomahawk has first appeared during the Xia Dynasty and became a symbolic implement of kingship and military power during the Shang Dynasty and the Zhou Dynasty (Yang 2003; Qian 2009). During the Warring States Period in China, the prevalence of tomahawk faded during the war due to its large size and weight but was kept as a ceremonial implement during the military operations and weapon of execution for the nobilities (Yang 2003; Qian 2009). Besides, the early Chinese inscriptions carved on oracle bones and bronze vessels during the Shang and Zhou Dynasty reveal the execution of decapitation and the function of tomahawk as well (Li 2012; Rong 1985). The ancient Chinese character of chop call “Zhan (斩)” is consist of a headless person with a tomahawk (Fig. 8). This evidence strongly supported the speculation that the tomahawk is a possible implement for execution used for the decapitation in this case.

Reconstruction of the process of decapitation

Generally, the blow of decapitation comes from the direction which depends on the dominant hand of the executioner or the direction that the victim is facing. The force of the blow and

Fig. 7 The simulated experiment of the possible implement (tomahawk) on the axis

the weight of the implement create several kerfs to sever the muscles and ligaments, and then remove the head from the body. However, the cut marks of decapitation provide limited information regarding the timing and sequences of the head removal. Although five cut marks on the atlas, axis, and third cervical vertebra indicated that the cuts were made with a narrow blade posterior-anteriorly, the sequences of the chops were still unclear. Generally, the removal of the head from the body occurs along the mid-cervical region. In order to remove the head at this portion, it is necessary to cut through most of the soft tissues on the neck, and then, tilt the head back as far as possible to conduct the decapitation (Mckinley 1993).

By observing and analyzing the cut marks on the cervical vertebrae, the process of decapitation could be reconstructed based on locations and directions of the cut marks. Based on the location of the cut marks on the cervical vertebrae, the first cut mark is formed at the third cervical vertebra, which resulted in the severing of the longus colli and attached ligaments. Furthermore, the executioner moved the implement forward to the axis and inflicted the second chop. This chop cut off the

rectus capitis anterior, which located at the right side of the cervical vertebra, resulting in a deeper mark on the axis. Hence, the third chop resulted in the death of the individual, which cut through the vertebral foramen and damaged the spinal cord. The first three chops were relatively straight, indicating that the individual is in a position with his head lowered when being executed, whereby the executioner is standing in a higher position than the victim to wield the implement. The fourth and fifth cut marks were in a direction slightly from the right to the left inferior-superiorly. The cut marks on the inferior right is deeper than on the superior left, indicating that the vertebra on the right inferiorly is the location where the force first applied. The executioner is speculated standing on the left side of the victim, wielding the implement with two hands.

The first three cut marks led to the separation of the muscles, ligaments, and blood vessels at the neck and resulted in the individual's death. Observing from the remaining parts of the atlas and axis, only right transverse foramen and part of the anterior arch of the atlas were remained; the transverse foramen of the atlas is located superior to the transverse foramen of the axis on the left, indicating that the victim's head is turned to the left when the fourth and fifth chop performed. To summarize, in the commissions of execution, the process of the decapitation started with the victim kneeling down, drooping his head, and exposing the neck. The executioner is standing on the left side of the victim and performed the decapitation by using the tomahawk (Fig. 9). Three chops led to the death of the individual, and another two chops were performed with the assistance of another executioner holding the victim's head to the left. The last two chops were performed with greater strength to sever the head from the torso completely. It is worth noting that the location of the decapitation of this case is so high up on the neck, which is quite different from the other decapitation locating at a much lower location as C4-C6 (Harman et al. 1981; Bush and Stirland 1991; Waldron 1996; Pitts et al. 2002; Strauss et al. 2015).

Fig. 8 The characters related to “chop” meaning in ancient Chinese inscription (top: oracle bone script; below: bronze script)

Fig. 9 The sketch of the scenario of decapitation

This could be related to the position of the victim and the special implement being used.

Conclusion

Decapitation is a pervasive practice in ancient human societies throughout history. Although abundant historical records and some possible related archeological discoveries on decapitation have been recognized in Asia, especially in China, the scientific osteological analysis of the ancient practice is far less adequate. In the present study, a headless skeleton from a high-status noble's tomb in east China is identified as a victim of decapitation and further examined to reconstruct the process of execution in Bronze Age China for the first time. Five peri-mortem sharp force cut marks were observed on the posterior parts of the axis, atlas, and the third cervical vertebrae, and another one on the right second metacarpal. Combining the historical records, archaeological evidence, and the osteological characteristics, the identity of the individual could be a warrior of Chu state, who is decapitated during the war against the Qin State. The tomahawk is a possible implement used for the execution of decapitation, and the sequences of the cut marks and process were further discussed. The first three chops led to the severing of the muscles, ligaments tissue at the neck, and resulted in the individual's death, and another two chops severed the head from the torso completely. The results not only enrich our knowledge of the decapitation phenomenon in terms of war and execution, but also allow a better understanding of the history of ancient China.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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