

# A middle bronze age case of trephination from central Anatolia, Turkey

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**Bull Int Assoc Paleodont. 2009; 3(2):28-39.**

## Abstract

Trephination is known as one of the oldest forms of brain surgery. It has been identified in the remains from many archaeological sites from the Old and New continents. Anatolia also has several historical stratigraphy and trephination cases that have been described from various time spans and from different locations. Anthropological studies on Anatolian skeletal remains determined that trephination had been practised from Neolithic times to the period of the Ottoman Empire. This paper focuses on one of the ancient brain drilling surgical methods that was discovered on a skull at Acemhöyük, Aksaray-Turkey the site corresponds directly to the Old Assyrian Colony Period in Central Anatolia. Surgery had been performed on the left lambdoid suture of a middle aged female individual. During the first step in macroscopic analysis no significant evidence of healing was observed. However, radiological observation demonstrated that the individual did, indeed, survive for a certain time after the drilling surgery.

**Keywords:** Trephination; Acemhöyük-Purushanda; Anatolia; Middle Bronze Age; Assyrian Colony Period

## Introduction

The history of trephination practice has been known for a long time on Old World continents. It has been known that the oldest techniques in brain surgery in Anatolia were developed about 10.000 years ago (1, 2). The number of trephinations recovered from excavation sites in Anatolia has reached nearly 40 over the past several decades. Indeed, the aim of trephination is still unknown, however some of the

discoveries showed that it had been used for healing purposes of symbolic aims (3, 4, 5).

### *The Site*

The Achemhöyük site is one of Anatolia's very significant ruins and it was discovered by Nimet Özgüç with excellent results. The site is now being successfully excavated by Aliye Öztan, recipient of the same scholarship from the Department of Archaeology, Faculty of Letters of Ankara University.

The settlement is situated 225 km to the South of Ankara, and is 18 km to the north-east of Aksaray (the ancient Garsaurai Archaleia). It is on the southern bank of the Tuz Gölü (Salt Lake) and is in the town of Yeşilova. It is west of the Ankara-Adana highway and is 10 km to the North of the main east-west thoroughfare which connects Kayseri to Konya. The site mound is about 700-600 m high with four high points and some flat areas.

Achemhöyük had been a settlement area since the Chalcolithic and Early Bronze Ages, but its most brilliant era was during the Old Assyrian Colony Period, in the Middle Bronze Age. Apart from private houses, the discoveries from the period include a monumental palace which was destroyed by a great fire. The foundations were made of stone, while the walls were constructed of mudbrick and reinforced with wooden beams, as was the technique in all of Mesopotamia. So far, only 40 of the palace's rooms have been uncovered. The ruins are still intact and indicate it to be the largest Anatolian palace of this age. Among the items discovered in the rooms there were ivory works of art that had belonged to the furniture, as well as crystal and obsidian vases, bronze objects and also large quantities of stamp seal impressions on clay bullae. Some rooms were full of large pithoi used for storage purposes (6).

After the first quarter of the second millennium B.C., Achemhöyük lost its importance and was not inhabited for very long time after that. The South-western part of the mound reappeared as a settlement during the Hellenistic and Roman Ages. The objects from Achemhöyük have been donated to the Ankara Archaeological Museum for proper conservation and exhibition. A very fine collection of ivories, obtained through illegal excavation and black market sales of artefacts from our cultural heritage, can be seen at the Metropolitan Museum of Art in New York.

With the onset of the 2nd millennium B.C., Anatolia's political, socio-economic and cultural framework becomes somewhat better understood thanks to written documents. These allow a tentative historical framework for some regions in Anatolia; and some understanding of the ethnic (linguistic) distribution within individual cultural regions. As in earlier periods, these cultural regions reflected Turkey's geographical zones; the central Anatolian plateau, the western coastal region, the Upper Euphrates Valley, and, finally, the east - each represents a separate culture. They communicated amongst themselves out of economic interest, and were unified at times under the influence of local rulers' ambitions to expand their territories (7).

The Middle Bronze Age represents a period of unbroken cultural development that began in Early Bronze III. It was previously thought that this was the time of chiefdoms but these can now be identified as "kingdoms" thanks to information gathered from historical texts. The first historic period in this era has been named the "Assyrian Colony Period", after records left by merchants from Assur (N. Iraq/ Upper Tigris Valley) (8). The second historic period, the "Hittite Old Kingdom", refers to the dynasty of Hittite kings (of Indo- European ethnic stock) based in the Halys/Kızılırmak basin, and eventually from

capital Hattusha (modern Boğazköy-recently renamed Boğazkale- Near Sungurlu, Çorum). Kültepe (Kanesh), Acemhöyük, Alişar and Boğazköy were the principal Anatolian centers of the Colony Age.

These related sites have aided the process of coming to understand the time of Middle Bronze Age Anatolia, which was cca. 2000-1500 B.C.

The Middle Bronze Age in Anatolia is chronologically divided into the following periods:

- MBI cca. 2000-1850 B.C.: Kültepe, ancient Kanesh (near Kayseri, late 19th-early 20th centuries B.C.)
- MBII cca. 1850-1650 B.C. "Assyrian Colony Period" (central Anatolia): Kültepe II Mond level 8+ Karum II: cca. 1850-1750 B.C. (reigns of Assyrian Kings Erishum I to Pazzur Assur II), Kültepe Ib Mound level 7+ Karum Ib cca. 1730- 1700 B.C. (king Shamsi-Adad I to king Samsuiluna),
- MBIII cca. 1650-1500 B.C. including the Hittite Old Kingdom (cca. 1600-1500 B.C.) (9,10).

These absolute dates follow the Mesopotamian "Low Chronology". These periods correspond to the Old Assyrian and Old Babylonian Periods in Mesopotamia and to the Middle Kingdom (Dyn.XII) and 2nd Intermediate Period (Dyn.XIII-XVII) in Egypt.

Acemhöyük, the ancient name of which was perhaps Purushanda or Zalpa, is a significant site for Middle Bronze Age research in central Anatolia. The dendrochronological date for "Sarı Kaya Palace" at Acemhöyük is 1752 B.C., which corresponds to Kültepe 7+Ib. The Assyrian eponym (limu) lists for correspondence between Assyrian businessmen, especially from the Kültepe site, indicates synchronism between Acemhöyük and royalty at Assur, Shamsi-Adad, Mari, Nagihanum, daughter of Yahdun-Lim and perhaps Carchemish-Aplahanda (11,12). Anitta's dagger also provides data about Acemhöyük's local king and his campaign over these kings respectively. Also this dagger gives the names of the people and places of the period in Hittite cuneiform style writing. It is currently on exhibit at the museum of Anatolian Civilizations. The Anatolian sites relative to Acemhöyük are İkiztepe, near Bafra on the Black Sea, Karahöyük-Konya, Kaman- Kalehöyük Ilica and the cemeteries at Acemhöyük, Kültepe, Yanarlar near Afyon and on the Aegean coast/western Turkey. These sites provide evidence of the ruling presence of Troy VI, Panaztepe, Beycesultan V.

Arıbaş Cemetery is located about 500 meters away from Höyük and it is dated to the Old Assyrian Colony Period in the Middle Bronze Age. It was first discovered by a farmer in 1992, and was excavated in a series of sessions conducted in Dr. Enver Arıbaş' garden during 1993, 1995 and 1996. In total, 167 graves were found at the cemetery where a small area had been excavated. According to comparative dating, based on archaeological material, the cemetery was in use during the 18th century B.C. and mid-17th century B.C. Both cremation and simple inhumation were employed at Acemhöyük. These burial customs show similarity to those discovered at Osmanlıyığı and Ilica in Central Anatolia dated roughly to 2000 B.C. During research at Arıbaş Cemetery in the 1996 session, four burial types were noted: basic inhumation, cremation, and two more distinct inhumation techniques (13) (Table 1). The quality of craftsmanship displayed on the grave goods such as ceramics, stone, ivory, bronze, bone, lead and golden cups, ornaments, engraved boxes, wall lamps and seals, shows that the individuals were all middle class people from the community. Exactly the same things were found at other corresponding sites. This demonstrates that a combination of two burial customs were employed at all burial sites belonging to wealthy or middle class people at the Acemhöyük site, as well as at other corresponding

sites from the Assyrian Colony Period. This leads us to the conclusion that two different cultural groups lived together at one specific site and were involved in trading towards mutual gain. One of the groups was comprised of people indigenous to Central Anatolia, whereas the other group consisted of a merchant class, settled there but originating from outside of Anatolia (14). Also, it was a sizeable community, as adult remains were also found outside the cemetery in Acemhöyük.

*Table 1 Burial Customs and Types found at Aribaş Cemetery*

Burial Custom	Burial Type	N	%
Cremation	Urns	112	67,07
	Simple Cremations	27	16,17
Inhumation	Simple Inhumations	21	12,58
	Pithos	7	4,19
Total		167	100

### Materials and methods

When the remains from Aribaş Cemetery were excavated, and the related Höyük site data was evaluated along with these, it was found that the skeleton population of Acemhöyük consisted of 131 individuals; 30,5% and 68,5% buried by inhumation and cremation, respectively. The individuals' age and sex assessments were performed using standard osteological techniques recommended by Buikstra and Ubelaker (1994) (15). In Acemhöyük 22,9% of the individuals consisted of fetuses, infants and children. Sex and age determination of more than half of the individuals extracted from the cremation grave was not fully realized, and was achieved for roughly 55,1%. Apart from this, it is clear that individuals were burned after death and at a very high temperatures, in keeping with Acemhöyük burial custom. Bones were usually found in tiny pieces and almost all blue and white in colour.

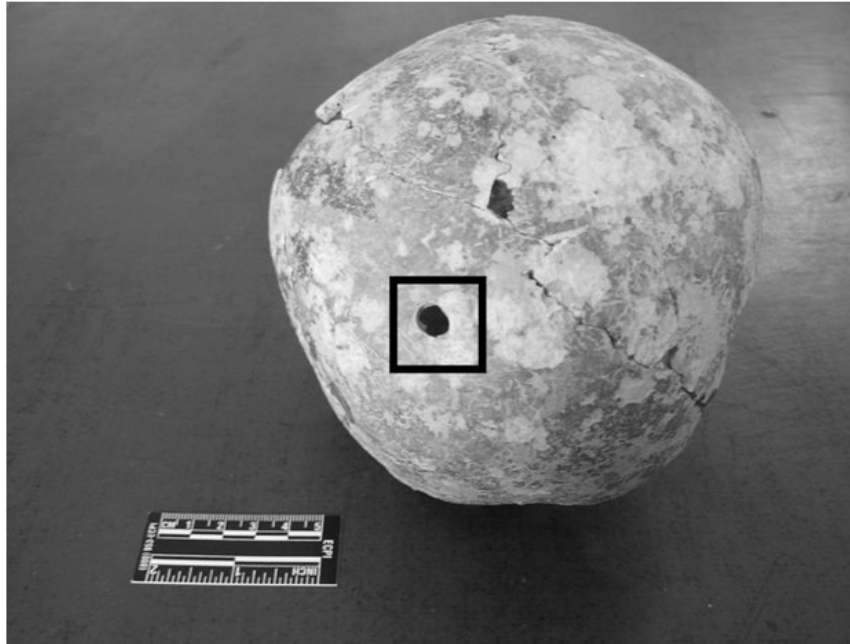
The cranial morphology of the individual displaying trephination indicates that the skull belonged to a female aged 45 years (15). Unfortunately, her facial bones, mandible and postcranial skeleton were missing. It could be directly related to some form of cult ritual involving the separation of the skull from the body after death, and the subsequent separate burial of the skull itself. So, there may be a secondary burial type. For these reasons, any aging method which could provide a more accurate result could not be successfully employed here. The ectocranial sutures were mostly closed, whereas the endocranial sutures were not. The age of the individual was estimated to be 45, according to the suture closing evaluation method recommended by Buikstra and Ubelaker. The preservation status of the cranium seems relatively fine. No pathological lesions were observed on the skull. Measurements taken of the individual's skull are listed in Table 2. According to the cranial index value (CI: 81, 66), the skull has been categorised as brachycranial (16). The brow arches and glabellae are not very pronounced. The bone structure is mostly tiny; muscle attachment areas are not distinct, either.

*Table 2 Cranial measurements.*

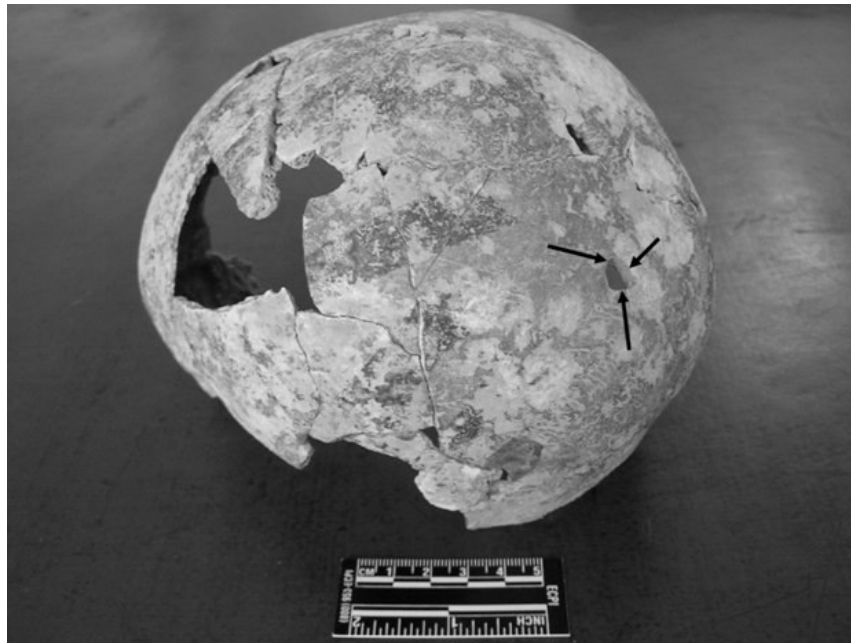
Measurement	mm	Measurement	mm
Maximum Cranial Length	173	Frontal Chord	111
Maximum Cranial Breadth	143	Parietal Arc	133
Maximum Frontal Breadth	113	Parietal Chord	114
Frontal Arc	134		

## Results

Trephination, achieved using a drilling technique, created a hole noted on the left lambdoid suture. The hole opened was 21,48 mm from the lambda. The width of the trephination hole, which is oval in shape, is 7,94 mm by 9,34 mm. From the ectocranial aspect, the hole seemed to have resulted from a single drilling, however from the endocranial aspect, it is understood that this was not the case. It seems that the hole was created in two separate drilling attempts. The internal walls of the hole are laterally inclined. This could indicate that under normal conditions, the person who performed the surgery stood on the right side of the individual submitted to trephination and had used his right hand, but this person was indeed left-handed. No sign of specific trauma or depression was found near the hole nor elsewhere on the skull. It is rather difficult to pin-point the reason why the operation was performed. The primary direction of the research led us to think that the person had died after the surgery. However, there was no sign of infection, which proved that the person survived the procedure and then died later, due to post-operative complications. Indeed, the radiological images provided more dependable information corroborating the theory that some degree of healing took place. It remains unclear how long the individual survived after the operation but it is certain that the individual stayed alive during the surgery. The mark of healing is almost too blurry to investigate macroscopically, and this survival period may be considered to have been relatively short (Figure 1-5).

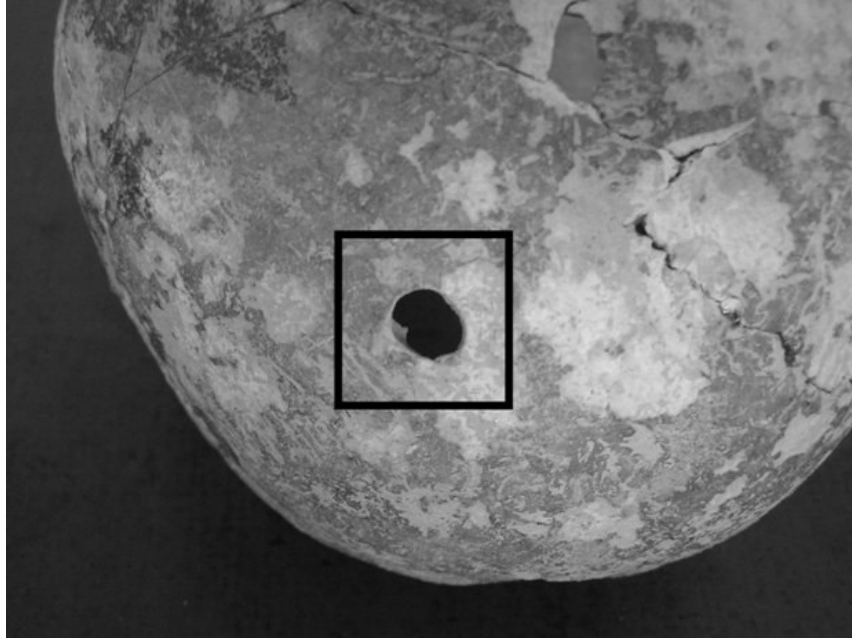


*Figure 1 Acemhöyük trephination from the posterior view.*

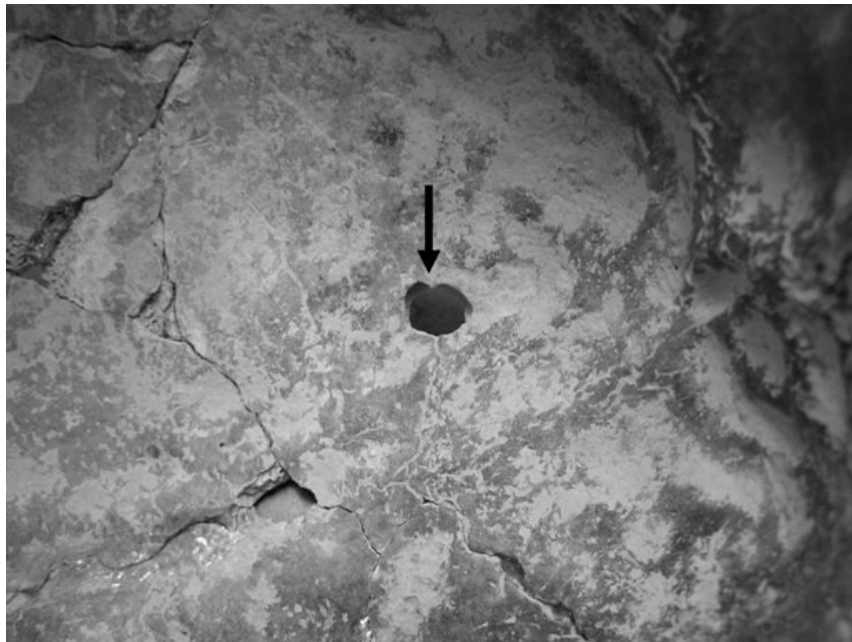


*Figure 2 Acemhöyük trephination from the lateral view.*





*Figure 3 Achemhöyük trephination from the superior view.*



*Figure 4 Trephined skull from Achemhöyük -endocranial view.*

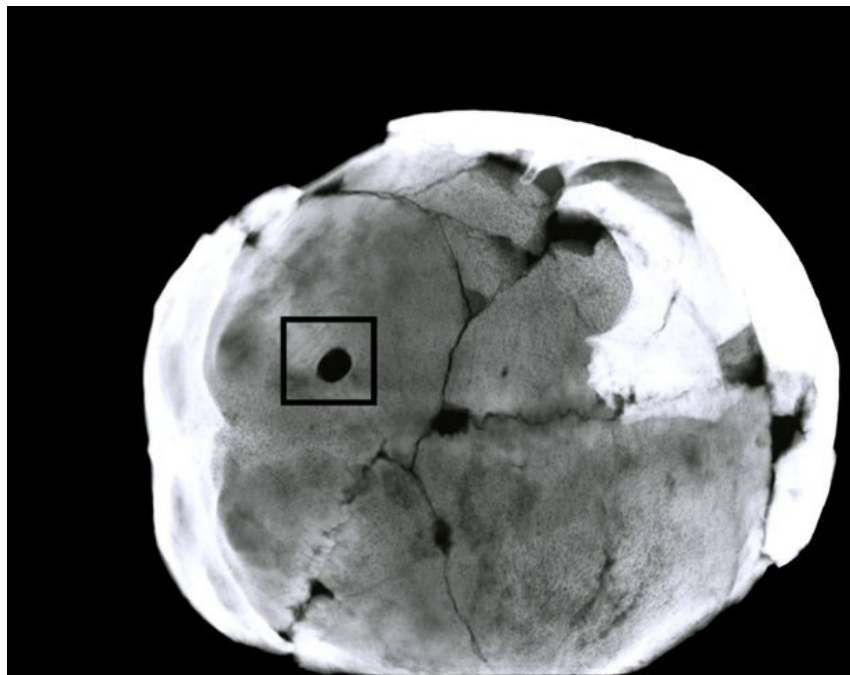


Figure 5 Radiograph of Acemhöyük skull from the basal view. Trephination hole lies on the lambdoid suture.

### Discussion

When our findings were compared with those from Kuruçay, located in Burdur-Tefenni, inland South of Anatolia, a site dated to cca 5500 B.C., the trephinate skull there attributed to the late Neolithic period or the early Bronze Age (2500 BC) differed from the Acemhöyük trephination sample: the Kuruçay skull has more than one hole. On the other hand, another technique was used on a sample from Kültepe, a site dated to the same period as Acemhöyük, which had quite intense socio-economic ties with the former (17). Aşıklı is another site of note - it is a settlement mound located nearly 1 km south of Kızılkaya village on the bank of the Melendiz brook, and 25 kilometres south - east of Aksaray. Aşıklı is located in an area covered by the volcanic tuff (ash) of central Cappadocia, in Aksaray Province. Another trephination sample was found at the Aşıklı Höyük archaeological site, first inhabited during the A ceramic Neolithic period, around 8000 B.C. (18). Upon comparison, these three trephination samples from Aşıklı, Kuruçay and Acemhöyük are vastly different and the distinct techniques employed at Kültepe could indicate that trephination was performed for a completely different reason at Acemhöyük. This conclusion was reached upon observing the pattern of the techniques applied at different sites and time periods in Anatolia. When compared with samples from the Near East, the Acemhöyük trephination seems similar to the sample from Jericho, Israel, where a Middle Bronze Age technique was used.

There have been various suggestions about the reasons why brain surgeries may have been performed in prehistoric society: medical spiritual treatment and ritual purposes (19, 20, and 21). Ancient drilling surgical procedures are commonly associated with head injury. In the absence lesions affecting the bone, it is difficult to determine the precise aim of trephination (20). In almost half of the



samples found in Anatolia, surgery seems to have been approached with the aim of rescuing individuals' lives after head trauma. Indeed, the extent to which prehistoric people understood human anatomy is a rather controversial issue. The reason behind the Acemhöyük trephination remains unclear. No signs of trauma or paleopathological lesion were found that could have affected the bone. The hole is located on the lambdoid suture, which is unusual, since sutures are areas to be avoided when performing a trephination procedure.

The most critical point in the Anatolian brain surgery samples is that they seem to have been performed for the purpose of treating head trauma. Furthermore, we believe that only a small number of surgeries were executed for ritualistic reasons. Behavioural disorders, headaches, dizziness, nervous temperament and even fainting, all of which stemmed from trauma, brain tumour, hydrocephaly, neurological and mental disorders were probably attributed to evil spirits and genies, and this would have comprised the other reasons for trephination. The belief that these could only be rid from the body through a hole drilled into the skull was an effective one in the prehistoric era. The Acemhöyük trephination sample is yet another piece of evidence substantiating the existence of an ancient custom of brain drilling whose origins reach as far back as cca 10 000 BC.

### Conclusions

The first trephination case among the civilizations of Anatolia was reported in 1958 by Şenyürek (22). Throughout the following 50 years the number of discovered trephination cases increased. Chronologically, the oldest reported trephination cases from Anatolia are from the Neolithic sites of Çayönü and Aşıklı Höyük (1, 2). Trephination cases which were carried out or were reported in various publications in Anatolia are given in Table 3 (1-5, 22-32).

Trading activity in Bronze Age Anatolia highly corresponds to trading in the Near East and Middle East regions at the same time. According to tablets from across the span of the Bronze Age, we assume that trading was not the only activity that took place between members of different groups and societies, as we also see cultural interaction among societies across the region. These people used different languages, one of which was likely to have been indigenous, whereas the others were from a foreign culture belonging to settlers in Anatolia who came to trade. We assume foreign traders were indeed the vector for cultural transfer into Anatolia. This is why we have come across different burial customs within the same region, as we did at the Near Eastern and Middle Eastern contemporary sites.

Anatolian trephination cases postulate great variety in drilling techniques. Surgical operations performed through drilling and cutting techniques had a higher probability of causing mortal outcome than techniques involving scraping and grooving movements (21). The sample most similar to the Acemhöyük trephination sample is the Aşıklı Höyük sample, which is dated to a time almost six thousand years before the Acemhöyük case. Although drilling was most likely also used to cure a mental disorder or a condition unrelated to bone injury. The possibility that individuals sharing the same grave had a distinctive status in their society should be taken into consideration at other sites. Hopefully, new samples currently being excavated at Acemhöyük will shed more light on these issues.

Table 3 Ancient Anatolian trephinations.

Site	Period	Technique	Sex	Age	Location	Healing	Researchers
Aşıklı Höyük	N	Drilling	Female	Adult	M Occipital	Present	Özbek, 1991
Çayönü	N	Drilling	Male	Sub Adult	Parietal	Absent	Özbek, 1998
Kuruçay	EC	Drilling	Female	Adult	R Parietal	Absent	Güleç & Pelin, 1998
Karataş	EBA	Trauma	?	Adult	L Temporal	Present	Angel, 1975
İkiztepe	EBA	Cutting	Male	Adult	R Parietal	Absent	Erdal, 2005
İkiztepe	EBA	Cutting	Male	Senile	R Parietal	Absent	Erdal, 2005
İkiztepe	EBA	Cutting	Male	Adult	R-L Parietal	Present	Erdal, 2005
İkiztepe	EBA	Scraping	Female	Sub Adult	R Parietal	Present	Erdal, 2005
İkiztepe	EBA	Drilling	Male	Adult	Bregma	Present	Erdal, 2005
Küçükhöyük	EBA	Grooving	Male	Senile	M Occipital	Absent	Güleç & Açikkol, 2001
Baklatepe	EBA	Scraping	Female	Adult	Sagittal Suture	Present	Erdal, 2006
Kültepe	MBA	Cutting	Male	Adult	L Occipital	Present	Şenyürek, 1958
Acemhöyük	MBA	Drilling	Female	Adult	L Lambdoid Suture	Present	in this study
Çavlum	MBA	Cutting	Male	Adult	L Coronal Suture	Absent	Güleç et al., 2004
Karagündüz	EIA	Drilling-Cutting	Male	Adult	R Parietal	Absent	Sevim et al., 2002
Karagündüz	EIA	Drilling-Cutting	Male	Adult	R Parietal	Absent	Sevim et al., 2002
Karagündüz	EIA	Trauma	Female	Adult	L Parietal	Present	Sevim et al., 2002
Karagündüz	EIA	Trauma	Female	Adult	R Coronal Suture	Present	Sevim et al., 2002
Hakkari	EIA	Drilling-Cutting	Female	Adult	M Frontal	Absent	Gözlük et al., 2003
Hakkari	EIA	Trauma	?	Adult	L Parietal	Present	Gözlük et al., 2003
Dilkaya	IA	Drilling-Cutting	Female	Sub Adult	Bregma	Present	Güleç, 1988
Dilkaya	IA	Drilling-Cutting	?	?	Parietal	Absent	Güleç, 1988
Perge	IA	?	Male	Adult	?	Absent	Abbasoğlu, 2006
Cevizciözü	IA	?	?	?	?	?	Erdal, 2006
Gordion	REP	Grooving	Male	Adult	L Coronal Suture	Present	Güleç, 1995
Gordion	REP	Trauma	?	?	L Coronal Suture	Absent	Güleç, 1995
Kovuklukaya	EBP	?	?	?	?	?	Erdal, 2006
İzник	LBP	Trauma	Male	Adult	Bregma	Present	Özbek, 1994
İzник	LBP	Trauma	Male	Juvenile	L Parietal	Present	Özbek, 1994
Dilkaya	MA	Trauma	?	Adult	L Parietal	?	Güleç, 1995
Van Castle	MA	Grooving	?	Adult	L Frontal	Present	Gözlük et al., 2004
Ottoman	LOP	Trauma	Male	Adult	L Parietal	Present	Güleç, 1995
Ottoman	LOP	Drilling	Female	Adult	L Parietal	Present	Güleç, 1995
Ottoman	LOP	Cutting	Male	Senile	L Parietal	Present	Güleç et al., 1999

N: Neolithic; EC: Early Chalcolithic; EBA: Early Bronze Age; MBA: Middle Bronze Age; EIA: Early Iron Age; IA: Iron Age; REP: Roman Imperial Period; EBP: Early Byzantine Period; LBP: Late Byzantine Period; MA: Medieval Age; LOP: Late Ottoman Period; R: Right, L: Left, M: Median Sagittal Line

### Acknowledgements

We would like to thank Prof. Dr. Aliye Öztan, lecturer at the Archeology Department of the Faculty of Letters, Ankara University, as well as the excavation director for giving us permission to work on the Acemhöyük material. We also thank Dr. Semra Duran from the Department of Radiology, Numune Hospital for providing the radiology report, as well as Dr. Marie Henriette Gates, from the Department of Archaeology at Bilkent University, Faculty of Humanities and Letters, for sharing her great knowledge and insight into Near Eastern Studies.

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