Running head: 3D Facial Reconstruction From A Skull Of A Female Who Buried and Bound Using Hog-Tie; Found In Excavations At Aktopraklık, Bursa-Turkey Is 8500 Years Old

3D Facial Reconstruction from a Skull of a Female Who Buried and Bound Using Hog-Tie; Found In Excavations at Aktopraklık, Bursa-Turkey is 8500 Years Old

Bora Boz, Mehmet Zahit Sarıtaş, Ali Boz

Pamukkale University

Author Note

Bora Boz and Mehmet Zahit Sarıtaş, Department of Forensic Science, Faculty of Medicine, Pamukkale University, Denizli Turkey.

Ali Boz, Pamukkale University TecnoPark, Electrical and Electronic Engineer, Denizli Turkey.

Correspondence concerning this article should be addressed to Bora Boz, Pamukkale University Faculty of Medicine, Department of Forensic Science, 20100, Denizli, TURKEY. E-mail: bboz@pau.edu.tr

3D Facial Reconstruction From A Skull Of A Female Who Buried and Bound Using Hog-Tie; Found In Excavations At Aktopraklık, Bursa-Turkey Is 8500 Years Old

Copyright 2015 KEI Journals. All rights reserved.
ABSTRACT

There are many excavation centres in Anatolia, most combining international and national teams. Facial reconstruction has been done for many purposes, from forensic medicine to surgical requirement. Recently, it has become favourable in historical findings. Although there are a few techniques for face construction, ethnicity, geography, and age of the skeleton should be taken into account. The aim of this case report is to make a facial reconstruction using a different approach, using soft tissue thickness that specifically belongs to the Anatolian people. In the present study, a face is defined using four steps to reach a more accurate construction for Anatolians. First, a skeleton was examined, then soft tissue thickness determined by predefined-MRI pool data, followed by x-ray computed tomography of the skull, and finally, computer aided correction. At the end of this protocol, the face was reconstructed in the best way. Also, for the first time, it was printed using a 3D printer for further analysis and display. The skeleton was found in Aktoprallik-Bursa (West Anatolia) excavation. The skull was aged about 8500 years old, gender determined as female. All measurements of the whole skeleton and facial reconstruction showed high similarities to the people who lived in this region in history.

Key Words: forensic science, anthropology, facial reconstruction, 3D printer, Aktoprallik, Anatolia

3D Facial Reconstruction From A Skull Of A Female Who Buried and Bound Using Hog-Tie; Found In Excavations At Aktoprallik, Bursa-Turkey Is 8500 Years Old
Introduction:

Many different historic findings, mostly coins, jewellery, implements, and inscriptions, as well as sculptures, are displayed to people in museums. However, skeletal findings, especially human, are generally stacked in rear rows, without interest. Facial reconstruction is gaining popularity and recently historical skull work has become favourable. Facial reconstruction is important for many areas, especially forensic medicine (Wozniak, Moskala, Pohl, Latacz, Dybala, 2012).

Previously, many studies have made possible identifications of face (Miyasaka, 1999). There are three methods for face construction: American (by tissue thickness), Russian (by muscles), and Manchester (combination of tissue and anatomical) (Sever, 2007). The mostly used Manchester and Gerosimov techniques use clay that is harmful to skull and bone structures (Çağdır, 1997 & Clement, Marks, 2005 & Wilkinson, 2004 & Boz, Özdemir, Özer, Boz, 2012). A recent advancement in face construction is the computerized 3D face construction technique (Claes, Vandermeulen, Gref, Willems, Suetens, 2006). Ethnicities, geography, biological and historical age of the sample are very important parameters for determining the protocol and accurate reconstruction of a face. Routine and general techniques could be done, but special attention should be given to historical skeletons.

Archaeological findings can help in understanding historical homicide, execution, and religious rituals. Hence, among the many skeletal findings, this hog-tied case was preferred as it had already been aged and anthropometrical measurements were done.

The aim of this case report is to make a facial reconstruction using the measurements of the Anatolian peoples and 3D scanning and printing technique coded by special software.
Medical Research Archive
3D Facial Reconstruction From A Skull Of A Female Who Buried and Bound Using Hog-Tie; Found In Excavations At Aktopraklik, Bursa-Turkey Is 8500 Years Old

Using Hog-Tie; Found In Excavations
At Aktopraklik, Bursa-Turkey Is 8500
Years Old

Material and Methods:
Excavation Area

Aktopraklik mound is located west
and at 25 km distance from Bursa and the
east side of Ulubat Lake (Figure 1). The
mound has been excavated by a team led by
NecmiKarul since 2004 (Karul,
Özeren,2007). The mound has three
settlement areas (A, B, and C) and has very
important traces ofNeolithic and Chalcolithic
periods. The settlement, which was
unearthed in the oldest ruins, dates back to
the year 6500 BC (Budd, 2013).

Skeleton and facial construction

Many skeletons have been found in
the ruins of settlements. Some have been
buried in interesting positions. One skeleton
has forensic interest because it is buried and
bound using hog-tie (Figure 2) at area C. The
skeleton was aged by isotop analysis (Budd
2013). Gender of the skeleton detected as
female by standard anthropometric
measurement.

In the first step, the head of the
skeleton was examined by a forensic
medicine specialist; naked eyes and pieces
missing from the incomplete cranium were
reconstructed by hand (Iscan, Helmer, 1993).
In the second step, the skull was scanned
transversally by computer tomography
(Philips Brillance CT 16 V2.00) and dicom
files transferred to computer (Figure 3). In
the third step, soft tissue thickness data
obtained from the local population were
applied virtually on pc, with ten different
points defined on the cranium (Table 1)
(Figure 4) (Teke, 2010). In the fourth step,
fine corrections were carried by manually
using Blender version V2.74 (Photo 3).

Finally, virtual data were embodied by 3D
printer (Zortrax M200) using Acrylonitrile
butadiene styrene (ABS) plastic (Photo 5).

3D Facial Reconstruction From A Skull
Of A Female Who Buried and Bound
Using Hog-Tie; Found In Excavations
At Aktopraklik, Bursa-Turkey Is 8500
Years Old

Results:

Face construction was completed
(Fig 4) and 3D printing applied to both

Copyright 2015 KEI Journals. All rights reserved.
~ 4 ~
Forensic medicine and archaeology. A 3D printed sample of the skull was given to the excavation team to display in Bursa Archaeopark.

Discussion

For reconstructions of faces upon skulls, reconstructions are usually based on a meticulous anthropological and anatomical analysis of the particular skeletal remains (Setefan, Henneberg, 2001 & Prag, Neave, 1997 & Mays, 1998). From these observations the importance of fine tuning average anthropological values of soft-tissue thickness appropriate for that region of the face and for that particular set of remains can be assessed (Vincent, 2001). Facial tissue thickness is affected by age, gender, and factors related with environmental, ethnic, and genetic differences (Midori, Ricanek, 2008). Therefore, it is important to have a large series of data from each community, measuring facial soft tissue thickness with scientific methods. Facial thickness data from the Ankara Sample was used (Teke, 2010). These data were more reasonable for the Bursa region. The study provided the opportunity to try many types of skin, eyes, hair and other aspects on the 3D reconstructed face. 3D printing is very useful without disturbing the original findings and can be used widely in forensic, orthopaedic, educational and historical examinations as well as art exhibitions.

Acknowledgements

We thank to Assoc. Prof Dr Necmi Karul (Istanbul University, Prehistory Department) for providing excavation area, skeleton finding permission and related data, also we thank to Prof Dr Ibrahim Acikbas (Pamukkale University, Faculty of Medicine) for help writing and editing our manuscript.
References:


Copyright 2015 KEI Journals. All rights reserved.

~ 6 ~
Medical Research Archive
3D Facial Reconstruction From A Skull Of A Female Who Buried and Bound Using Hog-Tie; Found In Excavations At Akopriklik, Bursa-Turkey Is 8500 Years Old


Copyright 2015 KEI Journals. All rights reserved.

~ 7 ~
Figure 2 legend:

The photograph represents a section of the burial excavation. Four skeletons have been found by Karumet al. in the burial: an adult woman, man and two child skeletons. Two adults have been positioned back to back hands tied at back suggesting a possible sacrifice cult. Each child’s skeleton has been positioned between the adults’ legs, buried separately. Because the four skeletons were unearthed at different depth levels and for other reasons, a photograph of all four skeletons together could not be obtained.
Figure 3 Scanned image of the skull.

Figure 4 Used points showed in skull and digitally completed face construction

Figure 5. Half of the re contracted face printed as 3D.