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ACCESSORY MENTAL FORAMEN (AMF) IN THE BYZANTINE POPULATION OF GREAT GÖZTEPE TUMULUS/SAFRANBOLU

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ABSTRACT

Variations are one of the most important criteria to present the similarities and differences among populations and individuals. There are different variations that can also be observed on the mandible. One of these variations is the accessory mental foramen (AMF), which is rarely seen on jaws. The paleodemographic analyses conducted on the Byzantine skeletons found in Göztepe Tumulus showed that the population consisted of 24 individuals. Of those 24 individuals, the mandibles of 14 adults were examined macroscopically, and an AMF was found on 3 of them. The examination of the mental foramens (MFs) in terms of their shape showed that 9 oval and 5 circular MFs were found on the left sides of 14 mandibles, and 7 oval and 6 circular MFs were found on the right sides. The present study is important because it is the first study conducted on the AMFs belonging to the Byzantine population in Anatolia.

KEYWORDS: Variation, Accessory Mental Foramen, Paleodemography, Great Göztepe Tumulus, Byzantine Population

1. INTRODUCTION

Many skeletons have been found as a result of archaeological and anthropological excavations in Anatolia, spanning over a thousand years. Thanks to the paleoanthropological analyses performed on these skeletons, much basic information about their society, such as its health structure, demography, and variation, has been obtained. Variations are one of the most important things we can learn about society. Emerging as embryological development errors, variations are observed in several parts of the human body at different levels (Bergman et al., 1988). There are 4 main factors causing variations in the human skeleton anatomy: ontogeny, sex, geography, and individual (White, 2005). Variations are one of the most important criteria to present the similarities and differences among populations and individuals. One of the most important parts, which are examined while paleoanthropological analyses are being performed for population, is the jaw. In this respect, there are different variations that can also be observed on the mandible. One of these variations is the accessory mental foramen (AMF), which is rarely seen on jaws (Fig. 1). The detailed morphologic structure that reflects the results of isolation inbreeding, hybridization, drift and other phenomena responsible for the genetic composition of populations, makes dental analysis of human groups of great significance in the identification and classification of races (Ngeow et all., 2003)

Figure 1: Accessory mental foramen and mental foramen

The mental foramen (MF) is located on the central part of the mandibular body at equal distances to the lower and upper borders, and it is the hole of the mandibular canal (Canalis mandibulae) for opening outward (Fig. 1) (Kökten et al., 2004; Rajani Singh et al., 2010; Chandra et al., 2013). The MF is generally situated below the second premolars on both sides of the jaw, on the external surface of the mandible. However, studies have shown that its location can vary in populations with different biological diversity (Hauser et al., 1989; Balcıoğlu et al., 2011; Kumar et al., 2014; Chandra, 2005; Koyun, 2007).

The mental foramen is a strategically important landmark during osteotomy procedures, anesthetic nerve blocks and prevention of neurovascular complications after invasive procedures on the lower jaw. Its anatomy is important for evaluating the morphometric symmetry of the mental triangle, microscopic and macroscopic morphology and maturity of the human mandible, bone remodeling activity and paleoanthropologic features of the facial skeleton in different populations (Hasan, 2010).

The AMF is defined as a foramen other than the principle foramen, in the case of the presence of more than one MF in the mental foramen field (Balcıoğlu et al., 2009; Sinanoğlu et al., 2015) (Fig. 1). Researchers have found that the prevalence of an AMF is high in Asian and African populations, whereas it ranges between 2% and 6.5% in today's population in Turkey (Balcıoğlu et al., 2011; Sinanoğlu et al., 2015). Weidenreich (1936) reported that all homo erectus specimens found in a Zhoukoudian (Beijing) cave had multiple MFs. Moreover, studies conducted on the Neanderthals have shown that almost all individuals had an AMF, and this variation is used as one of the main criteria examined to make species identification for the Neanderthals (Hrdlicka, 1930; Akazawa et al., 1995; Şenyürek, 1946; Tillier, 1996; Hanihara et al., 2001).

In this context, the aim of this study is to determine the AMF, which is rarely observed in both skeleton populations and modern populations, among the individuals in the Byzantine population of Göztepe Tumulus. The findings about the AMF will provide a different perspective for determining the kinship between Anatolia populations. Moreover, assessing the shape, direction, size, and measurements of the MF in archaeometric terms is another aim of this study.

2. MATERIALS AND METHODS

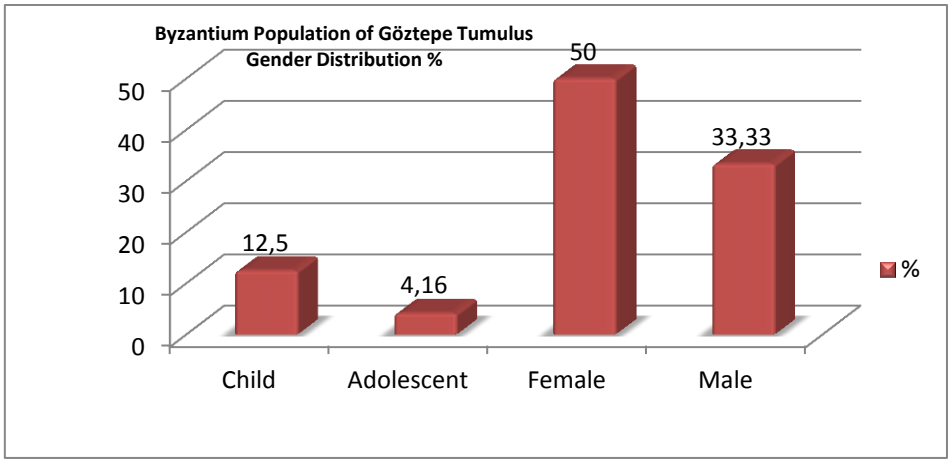
The material discussed in the present study was obtained from the Great Göztepe Tumulus in the Safranbolu District of Karabük Province in the western Black Sea region of Anatolia (Fig. 2). Göztepe Tumulus dates back to the Byzantine period (Figure 3). The tumulus excavation was conducted between 2011 and 2016 under the presidency of the Kastamonu Museum Directorate and with the scientific counseling of Associate Professor Şahin YILDIRIM.

Figure 2: Safranbolu, Turkey

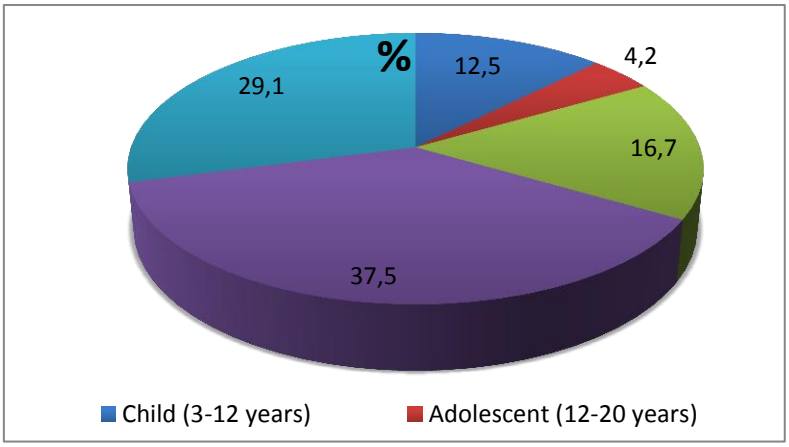
Figure 3: Great Göztepe Tumulus

The paleodemographic analyses of the skeletons obtained from the Göztepe Tumulus excavations were carried out according to Olivier, 1969; Workshop of European Anthropologist, 1980; Brothwell, 1981; Krogman and İşcan, 1986; Bass 1987; Ubelaker, 1989; Kaur and Jit, 1990; Szilvassy and Kritscher, 1990; White, 1991; Bruzek, 2002.

Table 1: Byzantium population of the Göztepe Tumulus gender distribution



These paleodemographic analyses conducted on the Byzantine skeletons found in Göztepe Tumulus showed that the population consisted of 24 individuals. Of these 24 individuals, 12 (50%) were female, 8 (33.33%) were male, 3 (12.5%) were children, and 1 (4.16%) was adolescent (Table 1). The examination of the population age distribution showed that 12.5% (n = 3) were children, 4.2% (1) were adolescent, 16.7% (n = 4) were young adults, 37.5% (n = 9) were middle-aged adults, and 29.1% (n = 7) were old-aged adults (Graph 1).



Graph 2: Byzantium population of the Göztepe Tumulus age distribution

Of those 24 individuals, the mandibles of 14 adult individuals were examined macroscopically, and an AMF was found on 3 of them. Moreover, the locations of the MF on the jaws were determined and their measurements were taken using a digital compass with 0.001 mm sensitivity. Whether the shapes of the MF were circular or oval was examined.

The measurements taken were as shown in Figure 4:

D1: Mean distance of the MF from the posterior border of the mandibular ramus
D2: Mean distance of the MF from the base of the mandible
D3: Mean distance of the MF from the alveolar crest
D4: Mean distance of the MF from the symphysis menti

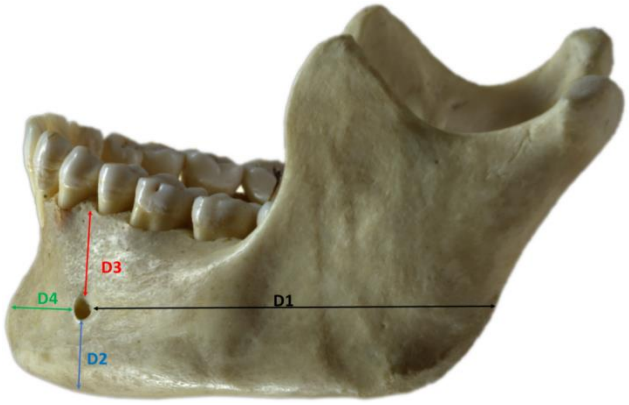


Figure 4: MF measurements

P2: Below the first premolar
P3: Between the first and second premolars
P4: Below the second premolar
P5: Between the second premolar and first molar
P6: Below the first molar

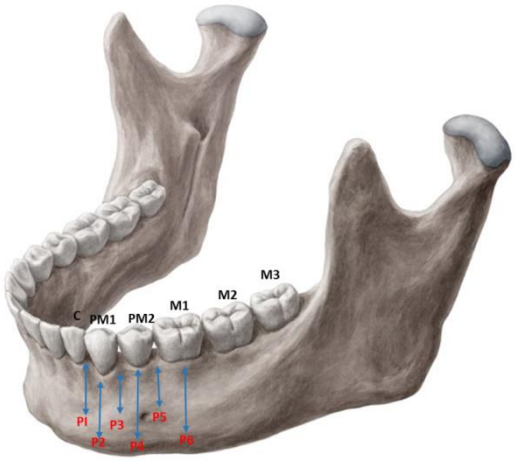


Figure 5: MF positions

3. FINDINGS

The shape, direction, size, and location of the MFs, which were found on 14 mandibles of 24 individuals from the Byzantine period in Göztepe Tumulus, were examined in this study. This examination showed that the MFs were positioned between the first and second premolars (P3) in 9 out of 14 mandibles, when the left side of the jaws was taken into consideration. This study also found that the MFs on 2 mandibles were situated below the second premolar, whereas the MF on 1 mandible was located below the first premolar. The examination of the MFs in terms of their shape showed that they were oval on 9 mandibles and circular on 4 mandibles. In terms of their sizes, the means of the

right and left MFs were found to be 3.80 and 3.83, respectively. The measurements of the MF showed that the means on the left and right sides were 69.27 and 69.56, respectively, for D1. For D2, the means on the left and right sides were 13.23 and 13.30, respectively. The left side mean was found to be 15.35, and the right side mean was found to be 15.04 for D3. The D4 means were found to be 24.42 for the left side and 25.34 for the right side (Table 2).

Table 2: MF measurements

Landmarks	Mean distances on the left side	Mean distances on the right side
D1	69.273	69.56
D2	13.23	13.3
D3	15.35	15.04
D4	24.42	25.34

The mandibles were examined in terms of the AMF, and it was found that there were AMFs on a total of 3 mandibles, including 2 mandibles of 1 female (Figure 6–7) and 1 male individual exhumed from the same grave, and 1 mandible belonging to a female individual exhumed from another grave (Fig. 8). The percentage of AMFs observed on the adult individuals whose mandibles were obtained was found to be 21.42, which was a high percentage (This ratio was found by the ratio of the number of AMF observed to the total jaw). An examination of the AMFs found on today's individuals in Turkey showed that its percentage ranged between 6% and 12.5%. The reason why the percentage of AMFs was high in the population of Göztepe Tumulus can be attributed to the fact that the number of samples examined was low. Studies reported that the AMFs did not show sexual dimorphism (Balcıoğlu et al., 2009; Balcıoğlu et al., 2011; Hauser and De Stefano, 1989). This is valid for the population of Göztepe Tumulus.

Figure 6: AMF

Figure 7: AMF

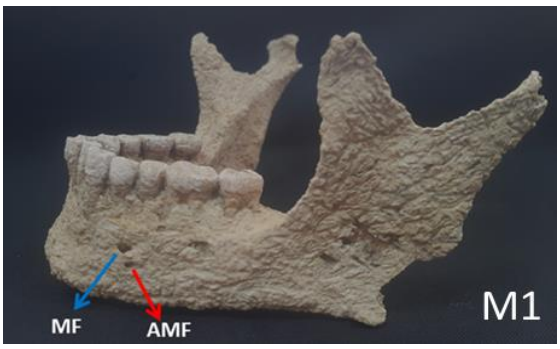


Figure 8: AMF

4. DISCUSSION AND CONCLUSION

The MFs were examined in terms of their shape, size, and position. Accordingly, the position of the MFs can be different in various populations in terms of location. In their studies, researchers stated that the MF was situated at different positions, such as below the second premolar, between the first or second premolar, or below the first premolar (Wang et al., 1986; Santini and Land, 1990; Phillips et al., 1992; Ikiz, 1997; Aktekin et al., 2003; Olasoji et al., 2004; Ari et al., 2005; Apinhasmit et al., 2009; Singh and Srivastav, 2011).

This study found that the MFs were between the first and second premolars. The examination of the MFs in terms of their shape showed that 9 oval and 5 circular MFs were found on the left sides of 14 mandibles and 7 oval and 6 circular MFs were found on their right sides. The number of oval MFs was found to be higher. Studies conducted by Al-Khateeb et al. (2007) and Singh et al. (2011) showed that the number of circular MFs was higher. Similar to the present study, a study conducted by Oliveira Junior (2009) reported that the number of oval MFs was higher. The distances of the MFs to the ramus, the base of the mandible, the alveolar crest, and the symphysis menti were compared with other populations, as seen in Table 3 (Wang et al., 1986; Souaga et al., 2004; Yeşilyurt et al., 2008; Singh and Srivastav, 2011). The Byzantine population in Göztepe Tumulus was found to be similar to the population examined by Sigh et al. (2011).

Table 3: Comparison of the mean distances of the MFs

Studies	Population	D1		D2		D3		D4	
		Left	Right	Left	Right	Left	Right	Left	Right
Wang et al.4 (1986)	Chinese mandibles	74.14		14.70				28.06	
Sigh et al. (1992)	North Indian population/Present Sample	76.7	65.8	13.17	14.3	15.6	15	22.6	24.7
Souaga et al.(2004)	Africans			14.89(Male) 14.21(Female)		16.16(Male) 15.66(Female)			
Igbigbi PS, Lesbona S. (2005)	Adult Malawian population/Present Sample	74.06	73.11	13.4	13.24	12.9	13.7	26.3	26.4
Yesilyurt et al. (2008)	Kenyan African mandible/Present Sampe	48.27	48.58					19.37	19.18
Rajani Singh & Shrivastav et al. (2010)	North Indian population/ Present Sample	84.7	71.8	13.3	17.3	18.6	17	30.6	29.3
Mishra & Mittal (2013)	North Indian population/Present Sample	76.11	65.47	14.01	14.53	15.36	14.86	23.04	25.28
Present Study	**Byzantium Great Göztepe population**	**69.27**	**69.56**	**13.23**	**13.3**	**15.35**	**15.04**	**24.42**	**25.34**

The AMF is defined as 2 or more MFs observed on the external surface of the mandible. The AMF was observed on 3 of 24 individuals found in the Byzantine population of Göztepe Tumulus. Of these individuals, 2 were young adult females and 1 was an old-aged male individual. Considering that the individuals found in the graves in most of the Tumuli in Anatolia shared kinship with each other, it is thought that these individuals were closely related to each other. In addition to this, the fact that 2 of the individuals, who were determined to have AMFs, were found in the same grave, strengthens this hypothesis. The AMFs were found only on the left sides of these 3 jaws (Figure 8). It is thought that the high prevalence (21%) of AMFs in the population may result from the low number of samples. Skeleton studies conducted on the Ancient Anatolia populations included hardly any information about the AMFs. A study conducted by Şenyürek (1946) was the only study on MFs. Şenyürek, in his study, discussed a MF with 4 or 5 holes, which was found on a mandible obtained during the Kusura excavation, dating back to the Bronze Age. Another study conducted by Şenyürek (1950), on a single individual, found that there was 1 MF on the right side of this individual's jaw and 2 MFs on its left side. A study conducted by Özbek (1987) reported that, except for 1 individual, others had 1 MF on their jaws. The present study is important because it is the first study conducted on the AMFs belonging to the Byzantine population in Anatolia. It will also provide an opportunity for further studies on AMFs in ancient Anatolian population to make comparison. This work is important because there are very few AMF studies done on old anatolian populations.

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REFERENCES

Akazawa, T., Muhesen, S., Dodo, Y., Kondo, O., Mızoguchı, Y., Abey et al. (1995). Neanderthal infant burial from the Dederiyeh cave in Syria. *PaleUorientals* 21, 77–86.

Aktekin, M., Çelik, H.M., Çelik, H.H., Aldur, M.M., & Akflit, M.D. (2003). Studies on the location of mental foramen in Turkish mandibles. *Morphologie* 87, 17–19.

Al-Khateeb, T., Al-Hadi Hamasha, A., & Ababneh, K.T. (2007). Position of mental foramen in northern regional Jordanian population. *Surgical and Radiologic Anatomy* 29, 231–237.

Apinhasmit, W., Methathrathip, D., Chompoopong, S., & Sangvichien, S. (2006). Mental foramen in Thais: an anatomical variation related to gender and side. *Surgical and Radiologic Anatomy* 28, 529–533.

Ari, I., Kafa, I.M., Basar, Z., & Kurt, M.A. (2005). The localization and anthropometry of mental foramen on late Byzantine mandibles: *Collateral Anthropology* 29, 233–236.

Balcıoğlu, H.A., & Kocaelli, H. (2009). Accessory mental foramen. *North American Journal of Medical Sciences* 1, 314–315.

Balcıoğlu, H.A., Köse, T.E., Keklikoğlu, N., Tuna, H., Erdem, T.L., & Özcan, İ. (2011). Anatomik Bir Varyasyon: Aksesuar Mental Foramen. *İstanbul Üniversitesi Diş Hekimliği Fakültesi Dergisi* 45–2, 65–68.

Bass, W.M. (1987). Human Osteology, A Laboratary and Field Mannual. Third Edition, Special Publication No: 2 of the Missouri Archaeological Society.

Bergman, R.A., Afifi, A.K., & Miyauchi, R. (1988). Catalog of Human Variation. Urban Schwarzenberg, Baltimore.

Brothwell, D.R. (1981). Digging up Bones. Oxford University Press British Museum (Natural History). London.

Bruzek, J. (2002). A method for visual determination of sex using the human hip bone. *American Journal of Physical Anthropology* 117, 157–168.

Chandra, A., Singh, A., Badni, M., Jaiswal, R. & Agnihotri, A. (2013). Determination of sex by radiographic analysis of mental foramen in North Indian population. *Journal of Forensic Dental Sciences* 5(1), 52–55.

Hanihara, T., & Ishida, H. (2001). Frequency variations of discrete cranial traits in major human populations. IV. Vessel and nerve related variations. *Journal of Anatomy* 199(3), 273–287.

Hasan, T. (2010). Characteristics of the mental foramen in different populations. *The Internet Journal of Biological Anthropology Volume* 4 (2), 1-7.

Hauser G, & De Stefano GF. (1989), Epigenetic variants of the human skull. Stuttgart: Schweizerbart'sche Verlag, p 301.

Hrdlicka, A. (1930). Skeletal Remaıns of Early Man, Smithsonian Institution.

Ikiz, I., & Erem, T. (1997). Relation of the mental foramen to teeth on the mandibles belonging to the Byzantium period. *International Journal of Anthropology* 12, 1–4.

Igbigbi PS, Lesbona S. The position and dimensions of the mental foramen in adult Malawian mandibles. *West African J Med. 2005;24(3):184-9.*

Kaur, H., & Jit, I. (1990). Age Estimation from Cortical Index of the Human Clavicle in Northwest Indians. *American Journal of Physical Anthropology* 83(3), 297–305.

Krogman, W.M., & İşcan, M.Y. (1986). The Human Skeleton in Forensic Medicine. 2nd. Ed. Charles C. Thomas, Springfield, Illinois.

Koyun, N. (2007). Foramen Mentale Asimetrisi, *Van Tıp Dergisi* 14(3), 80–82.

Kökten, G., Büyükanten, M., & Balcıoğlu, H.A. (2004). Foramen mentalenin çap ve lokalizasyonunun kuru kemik ve panoramik radyografide karşılaştırılması. *İstanbul Universitesi Dishekimligi Fakultesi Dergisi* 38(10), 65–71.

Kumar, V., Hunsigi, P., Kaipa, B.R., & Prasanna, M.D. (2014). Radiographic localization of mental foramen in Northeast and South Indian ethnic groups of Indian population. *Journal of Contemporary Dental Practice* 15(6), 766–769.

Mishra, A.B., Mittal,L. (2013), Anthropometry Study on Mental Foramen in Human Mandible, *International Journal of Science and Research (IJSR),905-906*

Ngeow, W.C., & Yuzawati, Y. (2003). The location of the mental foramen in a Selected Malay population. *Journal of Oral Science,* Vol. 45 (3), 171-175.

Olasoji, H.O., Tahir, A., Ekanem, A.U., & Abubakar, A.A. (2004). Radiographic and anatomic locations of mental foramen in northern Nigerian adults. *Nigerian Postgraduate Medical Journal* 11, 230–233.

Olivier, G. (1969). Practical Anthropology. Charles C. Thomas Publisher, Springfield, İllionis.

Oliveira Jr., E.M., Araiyo, A.L.D., Da Silva, C.M.F., Sousa-Rodrigues, C.F., & Lima, F.J.C. (2009). Morphological and morphometric study of mental foramen on the M-CP Jiachenjiang point. *International Journal of Morphology (Temuco)* 27, 231–238.

Özbek, M. (1987). Çayönü İnsanlarında Diş ve Dişeti Hastalıkları, V. *Araştırma Sonuçları Toplantısı* 5, 367–395.

Phillips, J.L., Weller, R.N., & Kulid, J.C. (1992). The mental foramen: size, orientation and positional relationship to the mandibular second premolar. *Journal of Endodontics* 18, 271–274.

Rajani Singh, R., & Srivastav, A.K. (2010). Evaluation of position, shape, size and incidence of mental foramen and accessory mental foramen in Indian adult human skulls. *International Journal of Experimental and Clinical Anatomy*.

Santini, A., & Land, M.A. (1990). Comparison of the position of mental foramen in Chinese and British mandibles. *Acta Anatomica (Basel)* 137, 208–212.

Sinanoğlu, A., Coşkunses, F.M., Kan, B., & Altan, A.B. (2015). Accessory Mental Foramen: Findings of cone-beam computed tomography, *Cumhuriyet Dental Journal* 18(2), 192–197.

Singh S K, Gopinathan K,et al Variation in position and number of mental foramen in mandibles of north Indian population. *J Anat Soc India 1992 ;41 (1) 47-51.*

Singh, R., & Srivastav, A.K. (2011). Evaluation of position, shape, size and incidence of mental foramen and accessory mental foramen in Indian adult human skulls. *International Journal of Experimental and Clinical Anatomy* 5, 23–29.

Souaga, K., Adon, A., & Angoh, Y. (2004). Topographical and morphological study of the mandibular foramen in black Africans from Ivory Coast. *Odontostomatol Trop* 27,17–21.

Szilvassy, J., & Kritscher, H. (1990). Estimation of chronological age in man based on the spongy structure of the long bones. *Anthropologischer Anzeiger* 48, 289–298.

Şenyürek, M.S. (1946). The multiplicity of Foramina Mentalia in a human mandible from the Copper Age of Anatolia. *Nature* 157, 792–793.

Şenyürek, M. (1950). Büyük Güllücek'de Bulunan Kalkolitik Çağa Ait Bir Muharibin İskeletinin Tetkiki. *Ankara Üniversitesi Dil ve Tarih-Coğrafya Fakültesi Dergisi*, Cilt 3.

Tillier, A.M. (1996). The Pech de l'Aze and Roc de Marsal children (middle Paleolithic, France): skeletal evidence for variation in Neanderthal ontogeny. *Human Evolution* 11, 113–119.

Ubelaker, D.H. (1989). Human Skeletal Remains: Excavation, Analysis, Interpretation. Washington: Taraxacum.

Wang, T.M., Shih, C., Liu, J.C., & Kook, J. (1986). A clinical and anatomical study of the location of the mental foramen in adult Chinese mandibles. *Acta Anatomica (Basel)* 126, 29–33.

Warwick, R. (1950). The relation of the direction of the mental foramen to the growth of the human mandible. *Journal of Anatomy* 84, 116–120.

Weidenreich, F. (1936). *The Mandibles of Sinanthropus pekinensis: A Comparative Study*. Beijing: *Palaeontologia Sinica*.

White, T.D. (1991). Human Osteology. University of California, Berkeley, California.

White, T.D., & Folkens, P.A. (2005). The Human Bone Manual, Published by Elsevier Academic Press, Burlington sf:32, 2005.

Workshop of European Anthropologist. (1980). Recommandations for Age and Sex Diagnoses of Skeletons. *Journal of Human Evolution* 9(7), 518–549.

Yeşilyurt, H., Aydınlıoğlu, A., Kavaklı, A. et al. (2008). Local differences in the position of the mental foramen. *Folia Morphol (Warsz)* 67. 32–35.