Eurasian Journal of Anthropology Eurasian J. Anthropol. 2(1):15−26, 2011

The incidence of mylohyoid bridging in prehistoric and historic Anatolian populations

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Received July 2, 2010
Accepted January 19, 2011

Abstract

In this study, the frequency of mylohyoid bridging (MHB) was investigated on 227 mandibles belonging to 8 prehistoric and historic Anatolian populations recovered from various archaeological sites dating from the Early Bronze Age (EBA) to the first quarter of the 20th century. The change in the frequency of MHB was analyzed in relation to age, sex, skull side, and population according to the criteria of Hauser and De Stefano (1989). The results revealed no significant relation between the occurrence of MHB and age or sex. An incidence rate of MHB varying between 6.07% and 30.00% was found in the Anatolian populations. The results revealed that these samples of ancient Anatolian populations exhibited a heterogeneous structure in view of the trait. However, the differences between the populations were not found to be statistically significant. When the population data is pooled, the frequency is 10.01%. This value falls within the levels of Europeans and Mongoloids. Bilaterality in the expression of MHB and its occurrence being independent of age and sex are findings that are consistent with the assumption that genetic background is relevant to its formation. Thus, MHB may be useful as a non-metrical feature in population studies when used in combination with other characteristics.

Keywords: *Skeletal biology, non-metric traits, mylohyoid bridge, ancient Anatolia*

Introduction

Mylohyoid bridge (MHB) is a hyperostotic variant where the mylohyoid groove (Fig. 1) becomes variably ossified (Ossenberg, 1974; Sawyer et al., 1978; Kaul and Pathak, 1984). Mylohyoid groove, beginning antero-inferior to the mandibular foramen and containing the neurovascular bundle, is normally closed over to become a connective tissue canal, which is the extension of the sphenomandibular ligament attached to the lingula. Either or both parts of this tissue may become partially or completely transformed into bone, forming bridges or an elongated canal, which may extend above the foramen (Scheuer et al., 2000). Ossenberg (1974) suggests that the precursor of this bridge is a membrane continuous proximally with the sphenomandibular ligament and stretching the ligament of the mylohyoid groove medial to the contained neurovascular structures. According to the investigator, this membrane and its bony variant may

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ISSN: 1309-2326

be derived from Meckel's cartilage. MHB may be seen as both incomplete (Fig. 2) and/or complete (Fig. 3) (Hauser and De Stefano 1989; Ossenberg, 1974; Sawyer et al., 1978; Kaul and Pathak, 1984). The clinical importance of this trait again centers on possible interference with administration of dental anesthesia (Scheuer et al., 2000; Stein et al., 2007).

MHB is a non-metrical trait that can be seen in varying frequencies among different regional human populations (Hanihara et al., 2003; Jidoi et al., 2000; Dodo, 1974; Ossenberg, 1974; Lundy, 1980; Sawyer et al., 1978). It has been regarded that the MHB is formed in correlation with genetic background and is one useful genetic marker for researching population relationships (Ossenberg, 1974, 1981; Jidoi et al., 2000). That's why the structure of MHB, similar to other non-metrical traits, is used to determine the relationships of biological distance between ancient populations (Corruccini, 1974; Sciulli, 1990; Ishida and Dodo, 1993; Milne et al., 1983; Berry et al., 1967; Berry, 1974, 1975; Hanihara et al., 2003; Van Gerven, 1982; Finnegan and Cooprider, 1978; Stefan, 1999; Stefan and Chapman, 2003; Rubini et al., 1999)

With regard to sex and age differences, no consistent trend has been presented. The mylohyoid bridge is expressed as a bony variant during adolescence. This variant is universally absent in mandibles of juveniles estimated to have been 11 years old or younger at the time of death. From 12 to 20 years of age there is a rapid rise in frequency (Ossenberg, 1974).

In this study the frequency of MHB in the mandibles of ancient Anatolian individuals, males and females aged between 18 and 65 years is examined. The aim is to utilize the data to determine the role of sex and age in the traits occurrence.

Materials and methods

The material of this study is comprised of 227 adult skeletons. These skeletons belong to individuals from 8 Anatolian populations who inhabited different areas in various historical periods ranging from the Early Bronze age to the first quarter of the 20th century. These skeletons are stored and protected in the Anthropology Laboratory of Hacettepe University.

The skeletons were recovered from archaeological sites and salvage excavations (Hakmehmet) in different geographic regions of Anatolia such as Marmara (İznik), Central Anatolia (Andaval), East Anatolia (Hakmehmet), the Black Sea (İkiztepe, Kovuklukaya), the Aegean (Cevizcioğlu, Yortanlı), and the Mediterranean (St Nicholas) and dated to different periods on the basis of archaeological findings on location. The time periods attributed to each population and the numbers of individuals representing these populations are shown in Table 1.

Table 1: Anatolian populations constituting the database and number of individuals

Population	Period	Reference	Number of individuals
Ikiztepe	Early Bronze	Bilgi (2001)	63
Cevizcioğlu	Hellenistic, Roman	Özkan and Atukeren (1999)	27
Yortanlı	Byzantine	Yaraş (2002)	11
Kovuklukaya	Early Byzantine	Özcan et al. (2003)	23
Andaval	Early Byzantine	Pekak (1998)	15
Iznik	Late Byzantine	Yalman (1983)	68
St Nicholas	20th century	Ötüken (1995)	10
Hakmehmet	20th century	Unpublished data	10
Total			227

Figure 1: No traces of bridging

Figure 2: Incomplete bridging

Figure 3: Complete bridging

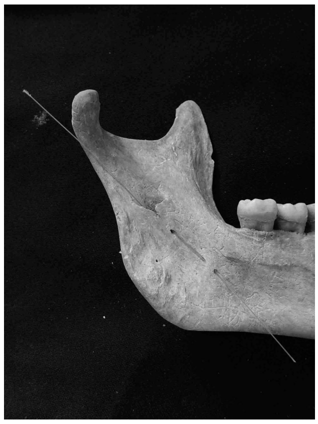

Figure 4: Proximal and distal types

The sex of the individuals in each sample was determined through the combined evaluation of long bones and body bones, with an emphasis on the anatomical details of the pelvis and the skull (Workshop of European Anthropologists, 1980). The joint processes of the long bones to the body, the particular joints of costa to sternum, the degrees of closure of the seams of the skull, and the degrees of deformation to the symphysis pubis related to aging (Buikstra and Ubelaker, 1994) were used to determine the age of the individuals. In determining the correlation between the individual's age and MHB, the individuals were grouped into three general age categories: 18-29 years, 30-44 years, and 45 years and over.

Hauser and De Stefano (1989) classify MHB according to:

1. Location of bridging
    a. proximal = in the vicinity of the mandibular foramen (Fig. 4),
    b. distal = approximately at the centre of the mylohyoid groove (Fig. 4),
    c. superior and inferior = interrupted canal formation, appearing as two separate bridges
2. Degree of bridging
    a. trace = formation of two spicules or lipping protruding from the edges of the mylohyoid groove
    b. partial bridging
    c. total bridging of the mylohyoid groove.

Data obtained from the skulls of the 8 Ancient Anatolian populations were evaluated using SPSS 13.01 software. While the χ^2 test was used for the identification of differences in populations, sex, and time periods. Fisher's exact χ^2 test was employed in cases where fewer than 5 samples were available.

Results

The frequency of MHB in the 8 skeletal populations shows a fluctuation between 6.7% and 30 % on the right side of the skull and between 6.7% and 20% on the left side. While the lowest frequency of MHB on both of the sides of the skull was found in the skeletal population from Andaval (6.7%), the highest frequencies are encountered in the population of the St. Nicholas (30% on the right, 20% on the left). As seen in Table 2, the other Anatolian populations exhibit different frequencies of MHB. No significant differences were found among populations in terms of the frequency of this variant in both sides of the skull (Table 2).

Since the results that are observed from Anatolian populations were not found to be statistically significant, the data of populations were collectively pooled. When the populations were evaluated together, the frequency of MHB was determined to be 10.1% and 8.8 % respectively for the right side and the left side. When the distribution of this variant was examined according to sex, it was found that females (12.1% on the right. 13.6% on the left) had a higher frequency than males (9.3% on the right. 6.8% on the left); however, this difference was not found to be statistically important (Table 3).

The number of bridges found on mylohyoid groove (sulcus) was also investigated. Double bridging was identified with a higher frequency (1.8%) on right side than on the left side (1.3%). When the frequency of double bridges was examined in relation to sex, it was observed that males (1.9%) had a higher frequency than did females (1.5%) on the right side; however, this difference was not found to be statistically significant (Table 4).

Table 2: The frequency of mylohyoid bridging in Anatolian samples

		Right				Left			
		Absence		Presence		Absence		Presence	
Population	N	n	%	n	%	n	%	n	%
Ikiztepe	63	58	92.1	5	7.9	57	90.5	6	9.5
Cevizcioğlu	27	24	88.9	3	11.1	25	92.6	2	7.4
Yortanlı	11	9	81.8	2	18.2	10	90.9	1	9.1
Kovuklukaya	23	21	91.3	2	8.7	20	87.0	3	13.0
Andaval	15	14	93.3	1	6.7	14	93.3	1	6.7
Iznik	68	62	91.2	6	8.8	63	92.6	5	7.4
St Nikolas	10	7	70.0	3	30.0	8	80.0	2	20.0
Hakmehmet	10	9	90.0	1	10.0	10	100.0	0	.0
Total	227	204	89.9	23	10.1	207	91.2	20	8.8

Right $X^2 = 5.858$, df = 7, $P = .556$; Left $X^2 = 3.410$, df = 7, $P = .845$

Table 3: The frequency of mylohyoid bridging according to sex

		Right				Left			
		Absence		Presence		Absence		Presence	
Sex	N	n	%	n	%	n	%	n	%
Male	161	146	90.7	15	9.3	150	93.2	11	6.8
Female	66	58	87.9	8	12.1	57	86.4	9	13.6
Total	227	204	89.9	23	10.1	207	91.2	20	8.8

Right $X^2 = .404$, df= 1, $P = .525$, exact= .628; Left $X^2 = 2.697$, df= 1, $P = .101$, exact= .122

Table 4: The number of mylohyoid bridges observed

		Right				Left			
		1		2		1		2	
Sex	N	n	%	n	%	n	%	n	%
Male	161	12	7.5	3	1.9	9	5.6	2	1.2
Female	66	7	10.6	1	1.5	8	12.1	1	1.5
Total	227	19	8.4	4	1.8	17	7.5	3	1.3

Right X^2 = .629, df= 2, P = .730; Left X^2 = 2.930, df= 2, P = .231

Incomplete mylohyoid bridging (15.1 % on the right side, 18.5% on the left side) in Anatolian populations is more commonly higher than complete bridging (10.1% on the right side, 8.8% on the left side), on both sides. On the other hand, the highest incomplete bridging (19.9% on the left side) was observed in males who had overall lower complete bridge frequencies on both sides than did females. The differences found between sexes are also not at statistically significant levels either (Table 5).

When the positioning of MHB is considered on the left side, the proximal type was found at a higher frequency (5.3%) than the distal type (4.4%). The frequency of both types of MHB on the same mandible was observed to be 2.2% on the right side. When the situation of MHB was examined according to sex, it was found that proximal type in females had a higher frequency than distal type on both sides. In contrast, neither type was observed on the left side in females. Moreover, the frequency of proximal type on the mandibles of females was higher than on the mandibles of males; however, this difference was not found to be statistically significant (Table 6). No cases of total bridging of mylohyoid groove, as described by Hauser and De Stefano (1989), were found in this study.

Table 5: The frequency of incomplete mylohyoid bridging according to sex

		Right						Left					
		Absence		Incomplete		Complete		Absence		Incomplete		Complete	
Sex	N	n	%	n	%	n	%	n	%	n	%	n	%
Male	161	119	73.9	27	16.8	15	9.3	118	73.3	32	19.9	11	6.8
Female	66	50	75.8	8	12.1	8	12.1	47	71.2	10	15.2	9	13.6
Total	227	169	74.4	35	15.4	23	10.1	165	72.7	42	18.5	20	8.8

Right X^2 = 1.041, df = 2, P = .594; Left X^2 = 3.052, df = 2, P = .217

Table 6: Location of mylohyoid bridging in relation to sex

		Right								Left							
		Absence		Proximal		Distal		Prox.–dis.		Absence		Proximal		Distal		Prox.–dis.	
Sex	N	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N	%
Male	161	146	90.7	5	3.1	7	4.3	3	1.9	150	93.2	5	3.1	4	2.5	2	1.2
Female	66	58	87.9	5	7.6	1	1.5	2	3.0	57	86.4	7	10.6	2	3.0	0	.0
Total	227	204	89.9	10	4.4	8	3.5	5	2.2	207	91.2	12	5.3	6	2.6	2	.9

Right X^2 = 3.519, df = 3, P = .318; Left X^2 = 6.092, df = 3, P = .107

When the distribution of MHB was examined in relation to age, the highest frequency of MHB (13.8%) was observed in the age group 45+ years on the right side, while the lowest frequency (6.0%) was found in the 30-44 years group on left side. Skulls in the 18-29 years age group that exhibited a value closer to that of the 45+ age group were found to have a frequency on left and right sides (12.3%) that are equal. The difference among age groups was not statistically significant either (Table 7).

As far as the number of bridges in MHB is considered, single bridging occurs more frequently on the right side for the 18-29 years group and on left side for the 30-44 years group. The incidence of double bridging was found with equal frequency on the both sides in the 30-44 years age group. While there was no observed bridging on the left side in the 45+ years group, the frequency of this trait was observed at 6.9% on the right side. No significant difference was found among age groups with respect to bridge number (Table 8).

In respect to the incidence of incomplete mylohoid bridging in relation to age groups, the results indicated that both incomplete and complete MHB frequencies were higher on the right side than on left side for all age groups. While the frequency of incomplete MHB decreased from the age group of 18-29 to the 45+ group, the frequency of complete MHB increased in the same age groups. Interestingly, the lowest frequency of MHB was found in the 30-44 years age group. The difference among age groups was not statistically significant either (Table 9).

Table 7: The frequency of mylohyoid bridging in relation to age groups

		Right				Left			
		Absence		Presence		Absence		Presence	
Age	N	n	%	n	%	n	%	n	%
18-29	81	71	87.7	10	12.3	71	87.7	10	12.3
30-44	117	108	92.3	9	7.7	110	94.0	7	6.0
45+	29	25	86.2	4	13.8	26	89.7	3	10.3
Total	227	204	89.9	23	10.1	207	91.2	20	8.8

Right $X^2 = 1.628$, df= 2, $P = .443$; Left $X^2 = 2.509$, df = 2, $P = .285$

Table 8: The number of mylohyoid bridges observed in relation to age groups

		Right				Left			
		1		2		1		2	
Age	N	n	%	n	%	n	%	n	%
18-29	81	9	11.1	1	1.2	8	9.9	2	2.5
30-44	117	8	6.8	1	.9	6	5.1	1	.9
45+	29	2	6.9	2	6.9	3	10.3	0	.0
Total	227	19	8.4	4	1.8	17	7.5	3	1.3

Right $X^2 = 6.309$, df= 4, $P = .177$; Left $X^2 = 3.408$, df= 4, $P = .492$

Table 9: The frequency of incomplete mylohyoid bridging in relation to age

		Right						Left					
		Absence		Incomplete		Complete		Absence		Incomplete		Complete	
Age	N	n	%	n	%	n	%	n	%	n	%	n	%
18-29	81	54	66.7	17	21.0	10	12.3	51	63.0	20	24.7	10	12.3
30-44	117	92	78.6	16	13.7	9	7.7	91	77.8	19	16.2	7	6.0
45+	29	23	79.3	2	6.9	4	13.8	23	79.3	3	10.3	3	10.3
Total	227	169	74.4	35	15.4	23	10.1	165	72.7	42	18.5	20	8.8

Right $X^2 = 5.715$, df = 4, $P = .221$; Left $X^2 = 6.978$, df = 4, $P = .137$

Table 10: The positioning of mylohyoid bridging in relation to age groups

		Right								Left							
		Absence		Proximal		Distal		Prox.–dis.		Absence		Proximal		Distal		Prox.–dis.	
Age	N	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N	%
18-29	81	71	87.7	6	7.4	2	2.5	2	2.5	71	87.7	6	7.4	3	3.7	1	1.2
30-44	117	108	92.3	3	2.6	5	4.3	1	.9	110	94.0	3	2.6	3	2.6	1	.9
45+	29	25	86.2	1	3.4	1	3.4	2	6.9	26	89.7	3	10.3	0	.0	0	.0
Total	227	204	89.9	10	4.4	8	3.5	5	2.2	207	91.2	12	5.3	6	2.6	2	.9

Right $X^2 = 7.118$, df = 6, $P = .310$; Left $X^2 = 5.440$, df = 6, $P = .489$

In examining the location of mylohoid bridging in relation to age groups, the proximal type was found in to be generally greater in frequency than the distal type in all age groups. Frequencies of MHB showed differences on both right and left sides in all age groups. The highest frequency (10.3%) was observed in the age group 45+ on the left side, while the lowest frequency was found in the 30-44 years group on both sides. Still, this difference was not found to be statistically significant (Table 10).

Discussion

It is determined that the trait of MHB is most common among populations in the Arctic and New World samples, followed closely by those from western Eurasia. A westward shift in the occurrence of the trait can be found in European populations. The frequencies for the East and South Asian samples are lower than those found in the Pacific samples, including those from Australia (Hanihara and Ishida, 2001). The incidence rate for this study, varying between 6.07% and 30%, was obtained from the 8 prehistoric and historic Anatolian populations. This heterogeneous structure in the frequency of MHB can be related to the sample size of three populations (Yortanlı, St Nicholas and Hakmehmet). Therefore, it was safer to pool data on the Anatolian populations in assessing the incidence of the trait. The frequency of MHB in Anatolia was recorded as 10.1 % for the right side and 8.8 % for the left side. This figure corresponds to a value between those provided by Hanihara and Ishida (2001) for 81 populations from Central Asia and Europe. Similar results were obtained for frequency rates of hypoglossal canal bridging (Eroğlu, 2010) and metopism (Eroğlu, 2008) investigated on materials included in this research. Worldwide frequency distribution of MHB is given in the table arranged in ascending order of frequency percentages. Results in Table 11 show that the Amerind (Ossenberg, 1974), Aleut (Ossenberg, 1974) and Khoisan (Lundy, 1980) exhibit much higher frequencies than do the other samples. Samples having relatively low trait frequencies are French (Ossenberg, 1974) and Japanese ones (Ossenberg, 1974; Dodo, 1974).

Ossenberg (1974), reported that occurrence of MHB was rare before maturity. The researcher maintains that ossification of the membrane over the groove is associated with the pubertal growth spurt and those populations or individuals that reach puberty earlier should exhibit earlier signs of mylohyoid bridging. Ossenberg (1974) reported that MHB was absent in juveniles younger than 11 years old, and from 12 to 20 years of age there is a rapid rise in frequency. Similarly, Lundy (1980) observed six juvenile Khoisan jaws, none of which exhibited a MHB. However, Sawyer et al. (1978) observed this trait in two young specimens of Pre-Columbian Peruvians, whose ages were estimated at 6 and 9-10 years. Jidoi et al. (2000), in the Spitalfields collection, found the bridge type and a strong indication of the lingular type in the left mandible of an 11 year-old girl and in the right mandible of a 5-6 year-old boy, respectively. Previously, the increase in frequency from young to older adults was not studied. Therefore, it is not known for sure whether there have been variations in the frequency of the trait depending on age. Such variations based on age are evaluated in three age groups in this study. It is interesting that bridge frequency in the 30-44 years group turned out to be considerably lower than that of the age groups 18-20 and 45+ years. The findings of bridge frequency being higher in both the 18-29 and 45+ years groups revealed that the growth process was not restricted to the pubertal period as was claimed by Ossenberg (1974), but rather sustainable in the following ages too. Even more interestingly, bridge frequency on the right side in the 45+ group turned out to be higher (13.8%) than that in the 18-30 group (12.3%) (Table 7). Although there is not a statistically significant difference between the MHB and age, these findings evoke the effect of environmental factors in the formation of this trait.

Several researchers (Berry et al., 1967; Berry, 1974, 1975; Corruccini, 1974; Hanihara et al., 2003; Brasili-Gualandi and Gualdi-Russo, 1989) reported that on the whole non-metrical traits did not diverge (or very little if at all) on the account of sex. The sex

Table 11: Worldwide distribution frequency of mylohyoid bridging

Population/Group	N*	%	Author(s)
Europe, France	844	00.47	Ossenberg (1974)
Japanese	208	02.90	Ossenberg (1974)
Japanese (Honshu)	354	04.20	Dodo (1974)
India (pooled)	376	04.26	Kaul and Pathak (1984)
Andhra Pradesh (India)	152	04.60	Kaul and Pathak (1984)
India	350	04.90	Ossenberg (1974)
Thai	273	05.10	Ossenberg (1974)
Hawaiian	865	05.30	Ossenberg (1974)
Eskimo, Alaska	529	05.50	Ossenberg (1974)
Australia, Aborigines	605	06.10	Ossenberg (1974)
Israel	30	06.67	Hanihara and Ishida (2001)
Ainu	104	06.70	Ossenberg (1974)
Pueblo Bonito	60	06.70	Corruccini (1972)
Eskimo, Greenland	288	08.00	Laughlin and Jorgensen (1956)
Greece	24	08.33	Hanihara and Ishida (2001)
Anatolia (pooled)	**227**	**10.01**	**Present study**
Kazakhs	118	10.17	Hanihara and Ishida (2001)
American Negroes	364	10.44	Corruccini (1974)
Tagars	94	10.64	Hanihara and Ishida (2001)
American Whites	278	11.15	Corruccini (1974)
Ainu (Hokkaido)	274	11.70	Dodo (1974)
Tibetans/Nepalese	65	12.31	Hanihara and Ishida (2001)
Italy	113	12.39	Hanihara and Ishida (2001)
Afghanistan	32	12.50	Hanihara and Ishida (2001)
Amerind Pueblos	578	13.00	Ossenberg (1974)
France	23	13.04	Hanihara and Ishida (2001)
Amerind Pueblos (pooled)	517	13.15	Corruccini (1972)
Eastern Europe	68	13.24	Hanihara and Ishida (2001)
Turkey/Cyprus	15	13.33	Hanihara and Ishida (2001)
American Negro	234	15.40	Sawyer et al. (1978)
American White	180	16.10	Sawyer et al. (1978)
Pre-Columbian Peruvians	244	17.60	Sawyer et al. (1978)
Amerind, Pacific Northwest	282	19.10	Ossenberg (1974)
Germans	51	19.61	Hanihara and Ishida (2001)
Amerind, Nadene, Alaska, and Canada	126	26.20	Ossenberg (1974)
Aleut	267	30.00	Ossenberg (1974)
Khoisan, Africa	146	32.20	Lundy (1980)
Amerind, Minnesota, Manitoba, and Dakotas	512	32.20	Ossenbeg (1974)

*Number of mandibular sides considered.

of an individual has varying effects on MHB formation in different populations. While Sawyer et al. (1978) found a significant difference in the populations they studied, Lundy (1980) observed little difference in the incidence of MHB between sexes in the Khoisan sample, and Corruccini (1974) detected similar frequency rates in both sexes. Jodai et al., (2000) who used the Spitalfields and modern Japanese cranial series, reported that the occurrence of the MHB was independent of sex and age after the maturation period. Ossenberg (1969), Dodo (1974), and Furuta (1982) observed higher frequency rates in males than in females. However, though lacking in any statistical significance, the females in the Anatolian samples showed a MHB frequency rate approximately twice as big as that of males. No significant difference was found among the three age classes in each sex or between the two sexes in each age class. These findings indicate that the expression of the trait appears to be independent of age and sex.

The frequency of mylohyoid bridging on the left and right sides varies among populations. While Furuta (1982) found out a relatively high symmetric rate for this trait, Dodo (1974) determined a remarkable asymmetry frequency. Ossenberg (1981) and Sawyer et al. (1978) found a rather powerful trend for symmetry. A relatively high rate of symmetry was detected for the Carabelli trait of tooth variations (Eroğlu, 2009; Synder et al., 1969; Escobar et al., 1977; Kolakowski et al., 1980; Biggerstaff, 1973), which provides rather high hereditary repeatability (h = 90) (Townsend and Martin, 1992). In a study by Eroğlu (2009) on the same material used in this study to determine the Carabelli frequency Eroğlu established a rather high rate of symmetry of 97.6% between the left and right sides. The rather small asymmetric rate of 6.6% revealed in this study seems to be in close relation with the rate determined for Carabelli's trait ensured by the total symmetry rate of 93.4 %. For non-metrical traits, it has been suggested that appearance of the trait on both sides stemmed from genetic factors, (Ossenberg, 1981; Trinkaus, 1978; Korey, 1980; McGrath et al., 1984; Brasili-Gualandi and Gualdi-Russo, 1989), while appearance of the trait only on one side was due to environmental factors (Trinkaus, 1978; Korey, 1980; McGrath et al., 1984, Brasili-Gualandi and Gualdi-Russo, 1989). In her research on the hypoglossal canal, Eroğlu (2010) found a significant rate of asymmetry in the formation of incomplete bridging, unlike that in complete bridging. Though the difference between sides is not statistically significant, a similar condition is valid for MHB. Therefore, the present findings appear to suggest that the effect of environmental factors is rather small in the formation of MHB. Also, asymmetry between sides seems to change according to age group. For example, the same frequency of MHB was prevalent on both sides in the 18 to 29 age group and relatively similar frequencies also occurred in the 30-44 age group. Yet, it was observed that frequency difference on sides increased within the 45+ age group, especially in the number of bridge frequency. Considering that environmental factors might play a role in the case of asymmetry in the 45+ age group, it is therefore suggested that this group be not included in the research for MHB.

Further, the position of MHB exhibits variations depending on populations. The proximal type, which was observed in Anatolian populations with high frequency, was attributed to Europeans (Hanihara and Ishida, 2001; Jidoi et al., 2000). Proximal type of MHB is often observed in the Neandertals (Smith, 1978, Jidoi et al., 2000). Thorne and Wolpoff (1992) regard MHB as one of the characteristics, based on relatively high frequencies of this trait in upper Paleolithic and recent Europeans that form the morphological basis of the multiregional model for the origin of anatomically modern humans in western Eurasia. However, Hanihara and Isida (2001) argue that the proximal type was not restricted to Europeans, but also occurred in Arctic and Sub-Saharan African populations. According to researchers, this feature is a European regional character, but not uniquely so. Accordingly, proximal type (5.3%) was observed in Anatolian populations more frequently than distal type (2.6%).

The value of Mylohyoid bridging as a genetic marker has not yet been established. However, bilaterality in the expression and the occurrence of the trait, independent of age and sex, is consistent with the assumption that genetic background is relevant to its formation. According to Jodai et al. (2000), observations both in modern humans and Neanderthals indicate that the MHB begins to appear during a relatively early phase of development when an individual has been less influenced by environmental stresses. There appears to be no relation between mechanical stresses and the expression of this trait because the Eskimos and Australian Aborigines, known for their habitual use of the masticatory apparatus as a tool, do not show a high frequency of its occurrence (Smith, 1978). Moreover, relationships between human groups based on the frequency of MHB are compatible with those based on dental morphology and human genetic analysis (Jodai et al., 2000). All these findings are compatible with the assumption that the mylohyoid bridging is formed under some genetic background and is one of the useful genetic markers for researching population relationships. Moreover, Sawyer et al. (1978) consider MHB to be a significant genetic marker for Mongoloid ancestry. According to Lundy (1980), those with no Mongoloid origin indicate that MHB is not a genetic marker for Mongoloid affinity. However, Kaul and Pathak (1984) emphasize that its use as a genetic marker in absence of other discrete traits has serious limitations.

In conclusion, the range of variation for Anatolians generally falls within the known levels of variation for this trait. Its range of expression can be observed from among that of Europeans to the Mongoloid. No significant relation was observed between Anatolian populations on account of MHB. Notably, the high frequency observed of the proximal type reflects genetic similarity with Europeans. The results of this study show that MHB was not correlated with age and sex. However, the occurrence of a relatively high frequency of bridging in the 45+ age group suggests that this trait did not only occur in the pubertal period, but it also appeared during the following years of life, implying that the trait was subjected to environmental factors. Therefore, due to findings such as a high frequency of bilaterality in the appearance of the trait during childhood without any significant relation with age and sex, it is supposed that this trait could be considered a genetic marker. Finaly, it should be kept in mind that more comprehensive results could be obtained if MHB is assessed along with other non-metrical variants in studies concerning biological distance.

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