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Torus palatinus and torus mandibularis in skeletal remains from Xiongnu and Medieval period

Abstract. Oral tori are bony growth present in the oral cavity and are not considered as pathological lesions. Smaller tori do not cause any problems, but larger sized tori can result in significant problems. The aim of this study was to determine the prevalence of torus palatinus (TP) and torus mandibularis (TM) in the two historical periods Xiongnu and Medieval period. A total of 90 skeletal remains were examined from both the Xiongnu ($n=53$; 25 male, 23 female, 5 child) and the Medieval periods ($n=37$; 13 male, 19 female, 5 child), which stored at the Human Bone Collection of the Institute of Archaeology, MAS. A total of 8 Xiongnu individuals (15%) and 5 Medieval period individuals (13.5%) presented with TM, while 5 Xiongnu (9.4%) and 2 Medieval period individuals (5.4%) had TP. In both historical periods, TP and TM were more common in the 20-39 age group and more frequent in males than females. The correlation between the torus palatinus and the torus mandibularis is statistically significant at 0.01 level. The results of the present study demonstrate that the prevalence of tori in the studied Xiongnu and Medieval populations is low. There is a tendency for the prevalence of tori to increase with age, although this is not a statistically significant trend.

Keywords: *torus palatinus, torus mandibularis, Xiongnu, Medieval period*

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Хүннү болон Дундад зууны үеийн хүний ясан дээрх эрүү ба тагнайн торус

Хураангуй. Амны хөндийн торус нь амны хөндийд ажиглагддаг ясны ургалт бөгөөд энэ нь өвчлөлд ордоггүй байна. Жижиг хэмжээтэй торус нь тухайн хүний амьдралын чанарт нөлөөлдөггүй ба харин томоохон хэмжээтэй торус нь хэл ярианы хөгжилд нөлөөлөх зэргээр өдөр тутмын амьдралд хүндрэл учруулах боломжтой. Энэхүү судалгааны зорилго нь Хүннүгийн болон Дундад зууны үе дэх тагнайн торус болон эрүүний торусын тархалтыг тодорхойлох явдал юм. Уг судалгаанд ШУА-ийн Археологийн хүрээлэнгийн хүний ясны сан хөмрөгт хадгалагдаж буй Хүннү ($n=53$; 25 эрэгтэй, 23 эмэгтэй, 5 хүүхэд) болон Дундад зууны үеийн ($n=37$; 13 эрэгтэй, 19 эмэгтэй, 5 хүүхэд) нийт 90 палеоантропологийн хэрэглэгдэхүүнийг хамрууллаа. Судалгааны үр дүнд Хүннүгийн 8 бодгаль (15%), Дундад зууны үеийн 5 бодгаль (13.5%) нь эрүүний торусын эмгэгтэй байсан бол Хүннүгийн 5 бодгаль (9.4%), дундад зууны үеийн 2 бодгаль (5.4%) нь тагнайн торустай байжээ. Судлагдсан түүхэн үеүдэд тагнайн торус

болон эрүүний торус 20-39 насны бүлгийнхэнд түгээмэл тохиолдож байгаа бөгөөд хүйсийн хувьд эмэгтэйчүүдээс илүү эрчүүдийн дунд илүү ажиглагдаж байна. Тагнайн торус болон эрүүний торус хоорондын хамаарал статистикийн хувьд 0.01 түвшинд байна. Энэхүү судалгааны үр дүнд судлагдсан Хүннү болон Дундад зууны үеийн хүн амд торусын тархалт бага байгааг харуулж байна. Торусын тархалт нас ахих тусам нэмэгдэх хандлагатай байдаг ч энэ нь статистикийн хувьд ач холбогдолтой хандлага биш юм.

Түлхүүр үг. Тагнайн торус, эрүүний торус, Хүннү, Дундад зууны үе

Introduction

Tori are benign exostoses that are formed by dense cortical bone and a limited amount of bone marrow. They are covered with a thin and poorly vascularized mucosa. The tori represent an anatomical variation rather than a pathological condition. Torus palatinus (TP) may be defined as an exostosis of the hard palate localized along the median palatine suture, involving both the processi palatini and the os palatinum [Haugen, 1992]. Torus mandibularis (TM) is defined as a bony protuberance on the lingual surface of the lower jaw, situated mostly in the canine and the premolar region, above the mylohyoid ridge [Axelsson et al., 1981]. The etiology of the development of tori is still unknown and several factors have been proposed such as: Genetic, masticatory stress, developmental anomalies, infection, malnutrition, and discontinued growth [Simunkovic et al., 2011]. Nowadays, the development of tori is considered as interplay of multifactorial genetic and environmental factors [Gorsky et al., 1950; Simunkovic et al., 2011]. This study aimed to determine the prevalence of TP and TM in relation to age, gender, and historical period and correlation between TP and TM in skeletal remains from the Xiongnu and Medieval period populations.

Materials and Methods

A total of 90 skeletal remains from both the Xiongnu ($n=53$; 25 male, 23 female, 5 child) and the Medieval periods ($n=37$; 13 male, 19 female, 5

child) were used for study purposes and are currently stored at the Human Bone Collection of the Institute of Archaeology, MAS. The skeletal remains utilized in the study were discovered in the Baruun belseg (Xiongnu) of Khutag-Цндүр soum and Zuun Bel (Medieval) of Dashinchilen soum of Bulgan province.

Standardized osteological methods for estimating the sex and age-at-death of skeletal remains are well established in biological anthropology. For each archaeological skeleton, age-at-death (e.g. morphological changes in the auricular surface, pubic symphysis) and sex (e.g. non-metric traits of the os coxa, cranium, mandible) estimations were carried out, employing methods that were dependent on the state of preservation and presence of relevant skeletal elements and features.

For the purposes of the study, a standardized data collection protocol was developed. One of the challenges of investigating mandibular tori and palatinus tori is morphological variation. The protocol involved the scoring, description, and assessment of the location, symmetry, and degree of mandibular tori and palatinus tori development.

SPSS Statistics, version 29.0 (IBM Corp., New York) was utilized for statistical analyses. A chi-square test was performed to measure the relationships between the categorical variables (Xiongnu/Medieval period, TM, TP presence/absence, male/female sex), the effects of the age cohorts on the TM, TP frequency data, and correlations between the variables were tested.

Table 1. Age and sex distribution of the skeletal samples

Period	Sex	Age (years)				Total
		0-19	20-39	40-59	60+	
Xiongnu	Female	1	10	6	6	23
	Male	-	12	9	3	25
	Child	5	-	-	-	5
Medieval	Female	-	5	11	3	19
	Male	-	3	3	7	13
	Child	5	-	-	-	5
Total		11	31	29	19	90

Result

The age and sex distribution of the skeletal samples is summarized in Table 1. Eight (15%) Xiongnu individuals out of 53 exhibited TM, and five individuals (13.5%) out of 37 Medieval period had TM (Table 2). In 8 Xiongnu archaeological individuals, the TM trait is expressed most commonly as round solitary nodules that are adjacent to the canines and premolars; the nodules are seen less frequently next to the first molars. In 5 Medieval period individuals with TM, expression of TM mostly exists as round solitary nodules adjacent to premolars and canines with infrequent occurrence next to first molars. The prevalence of TM in two historical periods, disaggregated by gender, reveals that male prevalence of Xiongnu is higher than Medieval period (Table 2); however, this difference is not statistically significant

($\chi^2=0.982$ $P=0.612$). Considering the distribution of TM by age group, it is common in the age group of 20-39 years of Xiongnu population (Table 3), nevertheless, it is not statistically significant ($\chi^2=2.243$ $P=0.524$). There are no significant differences of TM frequencies between the age categories in the Medieval period. The difference between sex and TM is significant at the 0.05 level. The correlation between the torus palatinus and the torus mandibularis is statistically significant at the 0.01 level.

With regard to TP, five (9.4%) Xiongnu individuals out of 53 exhibited TP, and two individuals (5.4%) out of 37 Medieval period had TP. In both historical periods, male prevalence of TP is higher than female. The difference between sex and TP is significant at the 0.05 level.

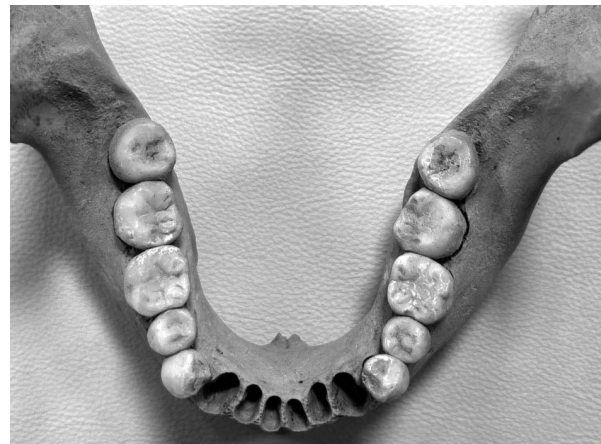


Figure 1. *Zuun Bel-19. Mandible with TM (left), Zuun bel-25. Mandible without TM (right)*

Table 2. Torus Mandibularis frequencies of Xiongnu and Medieval by sex categories

Period	Female		Male		Child	
	TM present	TM absent	TM present	TM absent	TM present	TM absent
Xiongnu	1	22	6	19	1	4
Medieval	1	18	3	10	1	4

Table 3. Torus Mandibularis frequencies of Xiongnu and Medieval by age categories

Age	Xiongnu		Medieval	
	TM present	TM absent	TM present	TM absent
0-19	1	5	1	4
20-39	6	17	1	7
40-59	1	14	1	13
60+	0	9	2	8
Total	8 (0.15)	45 (0.85)	5 (0.14)	32 (0.86)

Table 4. Torus Palatinus frequencies of Xiongnu and Medieval by sex categories

Period	Female		Male		Child	
	TP present	TP absent	TP present	TP absent	TP present	TP absent
Xiongnu	1	22	4	21	0	5
Medieval	0	19	2	11	0	5

Table 5. Torus Palatinus frequencies of Xiongnu and Medieval by age categories

Age	Xiongnu		Medieval	
	TP present	TP absent	TP present	TP absent
0-19	0	6	0	5
20-39	3	20	2	6
40-59	0	14	0	14
60+	0	8	0	10
Total	3 (0.06)	50 (0.94)	2 (0.05)	35 (0.95)

Discussion

Oral tori are bony growths that occur within the oral cavity and are not regarded as pathological lesions. Smaller tori do not impede eating, swallowing, speech, or the planning of partial or complete dentures [Yang, 1995]. However, larger tori can cause significant problems. TP is a bony protrusion typically located on the midline of the hard palate, while TM is seen on the sublingual part of the lower jaw [Yang, 1995]. The size of the tori can change throughout life, but they are typically less than 2 cm in diameter [Yang, 1995]. Their size can range from a few millimeters to centimeters. The available evidence suggests that the torus is more frequently observed in the middle phase of life. This indicates that the torus should be interpreted as a dynamic phenomenon rather than a stationary or progressively growing lump of bone [Miller & Roth, 1940; Eggen & Natvig, 1991; Haugen, 1992]. During lifetime, the torus responds not only to genetic factors but also to environmental and functional factors, particularly masticatory stress. Current researchers have suggested that palatal tori are an autosomal dominant trait. At present, the etiology of tori is considered to be multifactorial [Gorsky et al., 1950; Woo, 1950; Simunkovic et al., 2011].

The prevalence of TP varies in different populations. It is more common in Asian and Inuit Populations [Onho et al., 1988; Kerdpon et al., 1999; Yoshinaka et al., 2010]. The prevalence of TP was reported to be 47% and 61.1% in the Mongolians and Chandmani culture (5th-3rd century BC), respectively [Woo, 1950; Naran, 2003]. In the previous study [Erdene, 2003], among the Eastern Mongolians prevalence of TP was reported to be 69.2%. The

prevalence of TP among Xiongnu and Medieval periods in this study were 9.4% and 5.4%, respectively, which is much lower than the findings of other similar studies. Earlier studies revealed higher TP prevalence during the second and third decades of life [Bernaba, 1977; Haugen, 1992]. In this study, the prevalence of TP was lowest in the older age group. The 20-39 years age group showed the highest prevalence in this study (5 patients, 16.1%). Palatal tori are twice as common in females. However, the findings of the present study showed a higher prevalence in males compared to females. The findings of the present as far as gender is concerned differ from most of the previously mentioned studies, which showed a female predominance [Woo, 1950; Salem et al., 1987; Yoshinaka et al., 2010;]. However, Simunković *et al.* showed a higher male prevalence, similar to the findings of the present study [Simunkovic et al., 2011]. There is no specific reason for the female predominance, but genetics may be suggested as a major factor.

The prevalence of TM was reported to be 33% and 16.7% in the Mongols, Buriats and Chandmani culture (5th-3rd century BC), respectively [Hrdlicka, 1940; Naran, 2003]. The prevalence of TM among Xiongnu and Medieval period in this study were 15% and 13.3%, respectively, which is lower than the findings of Mongols and Buriats and much similar to Chandmani culture population. The prevalence may vary among similar ethnic groups living in different areas, or different ethnic groups living in same areas [King & King, 1981; Eggen et al., 1994]. The prevalence of TM among whites and blacks ranges from 8% to 16%, respectively [Gorsky et al., 1950;

Belsky et al., 2003]. Eskimo females (25.3%) were shown to have TM more commonly than males (13.3%) [Jarvis & Gorlin, 1972]. In contrast, the present study showed that Xiongnu males (10.5%) had TM more commonly than females (1.8%).

Conclusion

The results of the present study demonstrate that the incidence of occurrence of tori in the studied Xiongnu and Medieval populations is low. Furthermore, the presence of tori is significantly higher in males than in females in both historical periods. There is a tendency for the prevalence of tori to increase with age, although this is not a statistically significant trend. As we cannot draw conclusions to support specific causal factors responsible for the development of TM, future studies should test the genetic role, effects of mandibular robusticity, and age-related attrition in the occurrence of the tori. Tori is a dynamic phenomenon in the lifetime of an individual, and perhaps a longitudinal study of contemporary people through CT imaging could be employed to investigate the development of over time.

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