

Torus Palatinus and Torus Mandibularis in a Thai population

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ABSTRACT The aims of this study were to determine the prevalence, size, shape, and location of torus palatinus (TP) and torus mandibularis (TM), and to investigate their sex- and age-related differences in a Thai population. One thousand two hundred subjects were examined for the presence of both tori at the Faculty of Dentistry, Chulalongkorn University. The prevalence for TP and TM in the subjects was 58.1% and 31.9%, respectively. TP were significantly more common in females than in males (67.3% versus 48.8%; $p < 0.001$). TP were frequently found in small and medium sizes, spindle-shaped and often located at the combined premolar to molar and molar areas. The prevalence of TM was higher in males than in females (34.8% versus 29.0%; $p = 0.030$). TM occurred most commonly in small size, bilateral multiple form, and was often located at the canine to premolar area. There was a significant correlation between the prevalence of both tori and age ($p < 0.001$ for TP and $p = 0.004$ for TM). The prevalence of both tori in this Thai population were comparable to the Mongoloids and other Asian populations. Statistically significant differences in the prevalence and size of tori in regard to sex and age were also found.

KEYWORDS: torus mandibularis; torus palatinus; prevalence.

INTRODUCTION

The most remarkable exostoses of the human jaws are torus palatinus (TP) and torus mandibularis (TM). TP is a sessile nodule of bone that occurs along the midline of the hard palate. TM is a bony protuberance located on the lingual aspect of the mandible, commonly at the canine and premolar areas.¹ Although tori are not pathologically significant, they may obscure radiographic details of maxillary sinuses and lower premolars. They may also interfere with the construction and function of removable dentures, as well as oral functional movement.² The prevalence of tori varies widely in different populations, ranging from 0.4 % to 66.5% for TP³⁻¹⁷ and 0.5% to 63.4% for TM.^{3, 6-7, 9-12, 15-17} Racial differences appear significant, with a high prevalence in Asian and Eskimo populations.^{5, 9-11, 15, 18} Differences in the prevalence of tori between genders have also been reported. Most authors reported TP was more frequent in females,^{4-8, 12, 14-16} while TM affected more males than females.^{3, 11-12, 15-16, 19}

The etiology of tori has been investigated, however, no consensus has been found. The postulated causes

include genetic factors,^{11, 18, 20} environmental factors,^{8, 12, 19, 21} masticatory hyperfunction^{11-12, 15, 22} and continuous growth.²³ Recently, the etiology of tori has been postulated to be an interplay of multifactorial genetic and environmental factors.^{1-2, 12-13}

The present study was performed to determine the prevalence, size, shape and location of the tori and to investigate the sex- and age-related changes of TP and TM in a Thai population.

MATERIALS AND METHODS

Our subjects consisted of 1,200 Thais, including dental patients, staff and dental students of the Faculty of Dentistry, Chulalongkorn University. In order to give equal weight to all age and sex groups, 100 cases for each category were randomly selected from the accumulated data. The subjects were divided into six age groups: 13-19, 20-29, 30-39, 40-49, 50-59 and 60 years and over. The mean ages for males and females were 40.2 ± 17.5 years and 39.8 ± 17.3 years, respectively.

The presence or absence of tori was assessed by clinical inspection and palpation performed by one

examiner (AJ). Questionable tori were recorded as not present. In cases of positive finding, impressions of the maxillary and the mandibular arches were taken by using alginate impression material. Plaster casts were made for assessment of the size, shape and location of tori. The size of tori was measured at the highest elevation of the outgrowth by another examiner (WA) using calipers (Model 505-666, Mitutoyo Co, Japan) with output to the nearest 0.01 mm. Each torus was measured three times on separate occasions with at least two weeks interval. The average size of tori was graded according to the classification of Reichart et al¹¹ as follows: small (<3 mm), medium (3-6 mm) and large (>6 mm). The shapes of TP were classified as spindle, nodular, lobular and flat according to Neville et al.¹ The locations of TP were classified as premolar, molar, premolar to molar, incisor to premolar, and incisor to molar areas.

TM was identified by number of nodes and their placements into four categories: bilateral single, bilateral multiple, unilateral single and unilateral multiple, as previously described by Kolas et al.⁶ Locations of TM were recorded as incisor, incisor to canine, incisor to premolar, incisor to molar, incisor & premolar, canine, canine to premolar, canine to molar, premolar, and premolar to molar areas.

The Statistical Package for Social Science (version 7.5) was used for the analyses. The Chi-square test was used to test for group differences. To evaluate patterns of predictor influence, especially sex and age, on the prevalence of both tori, the logistic regression model was employed. Differences between groups with $p < 0.05$ were considered significant.

RESULTS

Prevalence

TP (Fig 1) and TM (Fig 2) were observed in 58.1% and 31.9% of the total subjects, respectively (Table 1). TP was found to be significantly higher



Fig 1. Lobular torus palatinus, a nodule of bone at the midline of hard palate in a Thai female, aged 48 years.



Fig 2. Bilateral multiple nodules of bony protuberance at the lingual aspect of mandible, the so-called torus mandibularis, in a Thai male, aged 53 years.

Table 1. Distribution of torus palatinus and torus mandibularis in relation to age and sex.

Age groups (years)	TP			TM			n	TP Total n (%)	TM Total n (%)
	n	Males n (%)	Females n (%)	n	Males n (%)	Females n (%)			
13-19	100	37 (37.0)	64 (64.0)	100	20 (20.0)	23 (23.0)	200	101 (50.5)	43 (21.5)
20-29	100	39 (39.0)	60 (60.0)	100	29 (29.0)	30 (30.0)	200	99 (49.5)	59 (29.5)
30-39	100	46 (46.0)	71 (71.0)	100	39 (39.0)	27 (27.0)	200	117 (58.5)	66 (33.0)
40-49	100	61 (61.0)	68 (68.0)	100	39 (39.0)	27 (27.0)	200	129 (64.5)	66 (33.0)
50-59	100	63 (63.0)	75 (75.0)	100	48 (48.0)	32 (32.0)	200	138 (69.0)	80 (40.0)
≥60	100	47 (47.0)	66 (66.0)	100	34 (34.0)	35 (35.0)	200	113 (56.5)	69 (34.5)
Total	600	293 (48.8)	404 (67.3)	600	209 (34.8)	174 (29.0)	1200	697 (58.1)	383 (31.9)

Sex versus prevalence of TP, $X^2 = 42.172$, $df = 1$, $p < 0.001$

Sex versus prevalence of TM, $X^2 = 4.698$, $df = 1$, $p = 0.030$

Age versus prevalence of TP, $X^2 = 24.168$, $df = 5$, $p < 0.001$

Age versus prevalence of TM, $X^2 = 17.369$, $df = 5$, $p = 0.004$

in females than in males (67.3% versus 48.8%; $p < 0.001$), while TM was found more often in males than in females (34.8% versus 29.0%; $p = 0.030$) (Table 1). There was a significant correlation between the occurrence of both tori and age ($p < 0.001$ for TP and $p = 0.004$ for TM in Table 1). In addition, the prevalence of TP was higher in females than in males in all age groups, while the prevalence of TM was higher in males than in females in the 30-59 year age group (Table 1). To simultaneously evaluate patterns of predictor influence, especially sex and age on the prevalence of both tori, the logistic regression model was employed (Table 2). Females were 2.2 times as likely to have TP and 0.8 times as likely to have TM as males. The odd ratios of TP when compared with the 13-19 year age group increased from 1.8 times in the 40-49 year age group to 2.2 times in the 50-59 year age group and then decreased to 1.3 times in the ≥ 60 year age group. The prevalence of TM when compared with the 13-19 year age group increased from 1.8 times in the 30-39 year age group to 2.4 times in the 50-59 year age group and decreased to 1.9 times in the older group.

Size, Shape and Location of TP

The relationship of TP occurrence and size to age and sex is shown in Table 3. Of the 697 TP studied, most were in small and medium sizes (29.0% and 24.9%, respectively). The age and sex differences in the distribution pattern of TP according to size were statistically significant ($p < 0.001$). The mean age of subjects having medium-sized TP (41.2 ± 15.3 years) was less than those having large-sized TP (49.7 ± 12.5 years) ($p < 0.001$), but it was not different from those having small-sized TP (39.9 ± 17.9 years). The medium- and large-sized TP tended to be found in females more than in males. The subjects in the older age group were more likely to have large-sized TP than those in the 13-19 year age group.

Table 4 shows the distribution of TP in relation to shape and size. Spindle-shaped TP was the most frequently observed, followed by the nodular TP. There was a relationship between shape and size of TP ($p < 0.001$). Most spindle-shaped TP were in medium and small sizes. Most nodular TP were of small size while most lobular TP were of medium size. All flat TP were small.

Table 2. Logistic regression model of torus palatinus and torus mandibularis.

Predictors	TP		TM	
	Odd ratio	p-value	Odd ratio	p-value
Sex (1=Females)	2.1963	<0.0001	0.7611	0.0292
Age 20-29 years	0.9593	0.8384	1.5300	0.0669
Age 30-39 years	1.3991	0.1020	1.8022	0.0101
Age 40-49 years	1.8203	0.0041	1.8022	0.0101
Age 50-59 years	2.2455	0.0001	2.4425	0.0001
Age ≥ 60 years	1.2852	0.2205	1.9278	0.0040

Males and age 13-19 years were used as references.

Table 3. Distribution of torus palatinus in relation to age, sex and size

Age groups (years)	Males			Females			Total					
	n	Small n (%)	Medium n (%)	Large n (%)	n	Small n (%)	Medium n (%)	Large n (%)	n	Small n (%)	Medium n (%)	Large n (%)
13-19	100	24 (24.0)	13 (13.0)	0 (0.0)	100	43 (43.0)	21 (21.0)	0 (0.0)	200	67 (33.5)	34 (17.0)	0 (0.0)
20-29	100	25 (25.0)	13 (13.0)	1 (1.0)	100	30 (30.0)	29 (29.0)	1 (1.0)	200	55 (27.5)	42 (21.0)	2 (1.0)
30-39	100	23 (23.0)	21 (21.0)	2 (2.0)	100	22 (22.0)	43 (43.0)	6 (6.0)	200	45 (22.5)	64 (32.0)	8 (4.0)
40-49	100	33 (33.0)	27 (27.0)	1 (1.0)	100	27 (27.0)	27 (27.0)	14 (14.0)	200	60 (30.0)	54 (27.0)	15 (7.5)
50-59	100	32 (32.0)	30 (30.0)	1 (1.0)	100	28 (28.0)	35 (35.0)	12 (12.0)	200	60 (30.0)	65 (32.5)	13 (6.5)
≥ 60	100	31 (31.0)	11 (11.0)	5 (5.0)	100	30 (30.0)	29 (29.0)	7 (7.0)	200	61 (30.5)	40 (20.0)	12 (6.0)
Total	600	168 (28.0)	115 (19.1)	10 (1.7)	600	180 (30.0)	184 (30.7)	40 (6.6)	1200	348 (29.0)	299 (24.9)	50 (4.2)

Age versus size, $X^2 = 36.212$, $df = 10$, $p < 0.001$

Sex versus size, $X^2 = 17.093$, $df = 2$, $p < 0.001$

Table 5 shows the distribution of TP in relation to age and location. The two most common locations for TP were the premolar to molar area and the molar area. Most TP in the 13-29 year age group were located in the molar area. There was an association between age and location of TP ($p < 0.001$). The number of TP located in the molar area when compared with the 13-19 year age group tended to decrease in the older age group. On the contrary,

the number of TP located in the premolar to molar area when compared with the 13-29 year age group tended to increase with age.

Size, Shape and Location of TM

Table 6 shows the distribution of TM in relation to age, sex and size. Of the 383 TM studied, most TM were small. There was a statistical correlation between age of subjects in the distribution pattern

Table 4. Distribution of torus palatinus in relation to shape and size.

Shape	Size			Total (n=697) n (%)
	Small n (%)	Medium n (%)	Large n (%)	
Spindle	157 (41.1)	197 (51.6)	28 (7.3)	382 (54.8)
Nodular	157 (64.6)	77 (31.7)	9 (3.7)	243 (34.9)
Lobular	9 (19.1)	25 (53.2)	13 (27.7)	47 (6.7)
Flat	25 (100.0)	0 (0.0)	0 (0.0)	25 (3.6)

Shape versus size, $X^2=97.009$, $df=6$, $p < 0.001$

Table 5. Distribution of torus palatinus in relation to age and location.

Age groups (years)	n	Location				Total n (%)
		Premolar area n (%)	Molar area n (%)	Premolar to molar area n (%)	Others n (%)	
13-19	200	2 (1.0)	66 (33.0)	33 (16.5)	0 (0.0)	101 (50.5)
20-29	200	4 (2.0)	59 (29.5)	36 (18.0)	0 (0.0)	99 (49.5)
30-39	200	6 (3.0)	51 (25.5)	60 (30.0)	0 (0.0)	117 (28.5)
40-49	200	11 (5.5)	47 (23.5)	71 (35.5)	0 (0.0)	129 (64.5)
50-59	200	10 (5.0)	47 (23.5)	80 (40.0)	1 (0.5)	138 (69.0)
≥60	200	12 (6.0)	47 (23.5)	53 (26.5)	1 (0.5)	113 (56.5)
Total	1200	45 (3.8)	317 (26.4)	333 (27.7)	2 (0.2)	697 (58.1)

Age versus location, $X^2=44.097$, $df = 15$, $p < 0.001$

Table 6. Distribution of torus mandibularis in relation to age, sex and size.

Age groups (years)	n	Males			n	Females			n	Total		
		Small n (%)	Medium n (%)	Large n (%)		Small n (%)	Medium n (%)	Large n (%)		Small n (%)	Medium n (%)	Large n (%)
13-19	100	14 (14.0)	6 (6.0)	0 (0.0)	100	19 (19.0)	4 (4.0)	0 (0.0)	200	33 (16.5)	10 (5.0)	0 (0.0)
20-29	100	21 (21.0)	8 (8.0)	0 (0.0)	100	24 (24.0)	6 (6.0)	0 (0.0)	200	45 (22.5)	14 (7.0)	0 (0.0)
30-39	100	24 (24.0)	12 (12.0)	3 (3.0)	100	13 (13.0)	13 (13.0)	1 (1.0)	200	37 (17.5)	25 (12.5)	4 (2.0)
40-49	100	21 (21.0)	17 (17.0)	1 (0.0)	100	24 (24.0)	3 (3.0)	1 (1.0)	200	45 (22.5)	20 (10.0)	1 (0.5)
50-59	100	24 (24.0)	18 (18.0)	6 (6.0)	100	23 (23.0)	8 (8.0)	1 (1.0)	200	47 (23.5)	26 (13.0)	7 (3.5)
≥60	100	21 (21.0)	9 (9.0)	4 (4.0)	100	16 (16.0)	16 (16.0)	3 (3.0)	200	37 (18.5)	25 (12.5)	7 (3.5)
Total	600	125 (20.8)	70 (11.7)	14 (2.3)	600	119 (19.8)	50 (8.3)	5 (0.8)	1200	244 (20.3)	120 (10)	19 (1.6)

Age versus size, $X^2 = 21.159$, $df = 10$, $p=0.020$

Sex versus size, $X^2= 4.584$, $df = 2$, $p=0.101$

of TM according to size ($p=0.020$). The occurrence of TM in small, medium and large sizes was not significantly different between males and females ($p=0.101$)

The mean age of subjects having medium-sized TM (44.0 ± 15.8 years) was less than those who exhibited large-sized TM (54.3 ± 11.7 years) ($p=0.007$), but it was not significantly different from that having small-sized TM (40.6 ± 16.7 years).

The distribution of TM in relation to number of nodes and placements is shown in Table 7. Most TM were bilateral multiple (59.5%), followed by the bilateral single (26.6%), unilateral single (11.0%) and unilateral multiple (2.9%).

Bilateral TM was found in the symmetrical pattern (64.2%) more than the asymmetrical pattern (35.8%). When TM was unilateral (single and multiple), it occurred more often on the left side (9.4%) than on the right side (5.5%).

The most common location of TM was the canine to premolar area (40.5%), followed by the premolar area (25.7%), canine area (13.8%), incisor to premolar area (7.0%), canine to molar area (6.8%), premolar to molar area (2.8%) and incisor to canine area (1.4%). The prevalence in other three locations was less than 1% each. No significant difference in location of TM was observed between right and left sides.

DISCUSSION

The prevalence of TP and TM in this study corresponds with previous results in Mongoloids and other Asian populations.^{5, 9-11, 15, 18} The high prevalence of tori in our study supports racial factor as one of the influences. Our results agree with most previous studies in showing that TP is more common in females,^{4-8, 12, 14-16} while TM is more common in males.^{3, 11, 12, 15, 16, 19} The prevalence ratios of males to females for TP and TM in this study are also in accordance with other studies in Thais.^{11, 15} Our study shows that females were 2.2 times as likely to have TP as males and 0.8 times as likely to have TM as males. Data from the present and previous reports

in Thais suggest that the expression of tori is a sex-related phenomenon. Haugen¹² stated that there was no obvious explanation for the gender differences but suggested genetics as a responsible factor. Alvesalo et al²⁴ studied TM in females with Turner syndrome (45, X) and suggested that sexual dimorphism in the manifestation of TM might result from the effect of the Y chromosome on the growth, occurrence, expression, and timing of development of TM. In the present study, the odd ratios of TP compared with the 13-19 year age group tended to increase with age from 40 to 59 year age group and those of TM tended to increase with age from 30 to 59 years. However, a trend for decreasing the occurrence of both tori was noted from the 50-59 year age group to the older age group. This variation in prevalence, therefore, should be influenced by functional factors. The regression of TP was probably observed after the extraction of teeth.²² Eggen & Natvig¹⁹ reported the similar result in Norwegians and surmised that decreased prevalence of TM among persons over 50 years of age was related to the decrease in number of remaining teeth. Sonnier et al¹⁶ stated that the prevalence of TM was directly related to the presence of teeth. Our results show that functional influences may contribute to the clinical expression of TP and TM. Most of our subjects in the 60 years and over age group were partially edentulous or completely edentulous, hence decreased masticatory function was certain. The lower occurrence of tori may correlate with less occlusal stress. We also observed a correlation between the occurrence of tori and severe attrition of teeth in our subjects as did Reichart et al.¹¹ The masticatory stress has been proposed as one of the etiologic factors. Eggen & Natvig¹⁹ have also correlated the high prevalence of TM with increased masticatory stress. Recently, a strong association between clenching and grinding and the presence of TM has been reported in Thais.¹⁵

There are divergent observations on tori in regard to age. Muller & Mayhall²⁵ reported a continuously increasing prevalence of TM with age. King & Moore⁸ reported no great difference in the percentage of tori affected below the age of thirty and assumed that there was little or no further growth of tori after the age of thirty. Other investigators reported a peak of occurrence of tori in the third decade of life.^{6, 7} Our observations showed a peak of occurrence of both tori in the fifth decade. The present study included equal distribution of subjects in every age group while other studies had an excess of younger individuals but a shortage of older ones. This may

Table 7. Distribution of torus mandibularis in relation to number of nodes and placements.

Placements	Number of nodes		Total (n=383) n (%)
	Multiple n (%)	Single n (%)	
Bilateral	228 (59.5)	102 (26.6)	330 (86.2)
Unilateral	11 (2.9)	42 (11.0)	53 (13.8)

explain why this study reported an older peak for occurrence of tori. We also found that subjects with older age were more likely to have medium- and large-sized TP than those with 13-19 year age group. In addition, the mean age of subjects with the large-sized tori was higher than those of medium- and small-sized tori. These findings support the association between age and continued growth of tori as reported by Topazian & Mullen.²³

Small tori were found more frequently than large tori, as in previous reports.^{4, 11-13} This finding contrasted with a study in Malaysia.⁹ Interestingly, our study showed that females had higher occurrence of TP and tended to have more medium- and large-sized TP than males, while the results were demonstrated vice versa for TM. This observation is in accordance with the study in Norwegians.¹² The large TP was found more common in older subjects as reported by Naidich et al.¹⁴

In a Singaporean study, Chew & Tan¹⁰ reported that 37% of TP occupied two-thirds of the palate and concluded that the Chinese tended to have rather large tori. Most TP in our study were in the premolar to molar area. The prevalence of TP in the premolar to molar area tended to increase with age. This finding implies that this group of Thais also tend to have rather large tori. In addition, during the first and the second decades of life, small-sized TP were found more frequently, but in the adult and older groups, the prevalence of medium- and large-sized TP increased. These findings indicate continued growth of TP in the forward direction from the molar area to the premolar area over time. The results supported the report of Gorsky et al¹³ that TP apparently grew with age from the molar area towards the premolar area.

In the present study, spindle-shaped TP was observed most frequently, followed by the nodular TP, as in Germans.¹¹ Lobular TP was found with lesser frequency. Some authors have reported the lobular TP to be the rarest type.^{5, 17} Kolas et al⁶ found the nodular TP to be the least frequent. The flat TP was the rarest type found in our study. This finding was in contrast with other studies in which this type of TP predominated.^{5-7, 17}

We observed more bilateral TM than unilateral TM and symmetrical occurrence predominated. These findings are in accordance with most studies.^{6, 11, 12} In our study, TM was found to be in multiple nodules more than in single nodule which was in contrast with others that reported single tori as the most common type.^{1, 6, 11, 12} We recorded unilateral TM more often on the left side of the mandible,

whereas the right side unilateral TM predominated in other reports.^{11, 14} We also found that most TM were located at the canine to premolar area as in the previous reports.¹

The high prevalence of both tori, as well as the differences in prevalence and size of tori with age and gender, support the hypothesis that torus should be considered a dynamic phenomenon, responding during life to environmental and functional factors, acting in a complicated interplay with the genetic factors.¹²

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