

Tori in a Malaysian population: Morphological and ethnic variations

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Abstract

Aim: Tori are nonneoplastic self-limiting, bony exostosis that are commonly called torus palatinus (TP) when seen on the hard palate and termed torus mandibularis (TM) when seen on the lingual surface of the mandible. These lesions have long been known to anthropologists and have mostly been identified incidentally during routine dental examinations. The prevalence of tori varies in different populations from 0.0% to 66% for TP and between 0.1% and 63.4% for TM. The exact etiology is still unclear, but the most accepted theory today is 30% attributed to genetics and 70% to environmental factors. Hence, the aim of this study was to determine the prevalence of tori and study their morphology among various ethnic groups of a Malaysian population. **Materials and Methods:** A cross-sectional study was conducted involving the screening of patients that reported to the oral medicine clinics over a 2-year period. Age, gender, ethnicity, morphological variations in shape and size, number, and location of tori were recorded in all positive cases. **Results:** Fourteen percent of individuals ($n = 624$) among the total 4443 who were screened were found to have either palatine tori, mandibular tori, or both. The prevalence of PT and MT was 10.8% and 0.9%, respectively. Tori were found in people in the age range of 5–85 years, with the maximum in the age range of 20–29 years (24.7%). The male-to-female ratio for PT and MT was 1:1.4 and 1:0.68, respectively. The morphologic shapes of palatine tori that were observed were flat (10%), spindle (10%), linear (15%), and nodular (59%) with up to six lobules. Mandibular tori were located either unilaterally or bilaterally; they were nodular in shape (89%) and/or band like (15%), with the band-like shape being described for the first time. Size variations ranging from 0.5 to 5 cm were observed. **Conclusion:** The relatively high prevalence of tori among major ethnic groups of this region supports the probable hypothesis of the role of environmental factors. A wide variation in the morphology was also noted, along with a new morphologic variant of band-like TM, which may be due to the influence of diet or an unknown environmental factor.

Key words: Band-like torus, mandibular tori, morphology, palatine tori

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Introduction

Tori are bony overgrowths commonly found on the midline of the hard palate or the lingual aspects of the mandible above the mylohyoid line.^[1] These developmental anomalies are considered as normal anatomic variations rather than pathologic conditions. The function of tori is questionable. In fact, tori are more of a hindrance as they can obscure radiographic details of lower premolars and the maxillary sinus. From a prosthetic standpoint, tori can hinder the construction and function of both the upper and lower dentures.^[2] Tori have also been implicated in the identification of human remains for forensic anthropology. Their presence along with other elements such as incisive papilla and the shape of the mid-palatal raphe can supplement the study of the palatal rugae.^[3] The prevalence varies widely from 0.4% to 61.7% for torus palatinus (TP) and 1%–64% for torus mandibularis (TM) in various population studies.^[4]

Gender differences in the prevalence of tori have also been reported, and most authors found TP more frequently in women, whereas TM was more common

in men. Tori are frequently observed in young adults and in middle-aged persons. It has been theorized that because some tori are found with some frequency during the middle phase of life, their occurrence may be not only due to a genetic cause but also due to environmental and functional factors, particularly those related to masticatory stress. Jainkittivong and Langlais surmised that the etiology of this common osseous outgrowth is probably multifactorial, including environmental factors acting in a complicated and unclear interplay with genetic factors.^[5]

The exact etiology is still unclear, but the most accepted theory today is that 30% are attributed to genetics and 70% to environmental factors.^[6] Malaysian population consists of three major ethnic groups: the Malays, the Chinese, and the Indians.

The aim of this study was to evaluate morphological variations in the presentation of tori in a Malaysian population, which primarily consists of three major ethnic groups: the Malays, the Chinese, and the Indians.



Figure 1: Palatine torus – flat



Figure 2: Palatine torus – nodular



Figure 3: Palatine torus – spindle



Figure 4: Palatine torus – lobular

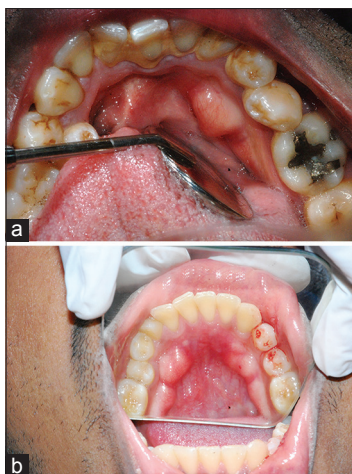


Figure 5: (a) Mandibular tori – nodular unilateral. (b) Mandibular tori – nodular bilateral

Materials and Methods

The study group comprised patients visiting the Oral Medicine and Radiology clinic in Penang International Dental College. A total of 4443 patients were examined, of which 1911 were males and 2532 were females [Table 1]. The patients were stratified into nine age groups ranging from below 9 years to 80 years and above [Table 2]. Informed consent was obtained and demographic details of the patients were recorded which also included their ethnic background. The presence of TP, TM, and buccal exostoses (BE) was recorded along with their number, location, shape, and size. The patient's awareness about the existence of the torus in the oral cavity and any symptoms associated with it was also noted. The shape of TP was classified as flat, nodular, spindle, and lobular according to the classification given by Jainkittiwong *et al.* Based on our observation, the shape of TM was classified as nodular and band like. The data thus obtained were subjected to the statistical analysis.

Results

Of the 4443 patients who were part of the study, 624 patients were found to have tori (14.04%). The total number of participants with only TP was 483 (77.08%) and the participants with only TM were 42 (6.73%). The participants who had both TP and TM were 104 (16.86%) and those with buccal exostoses were 20 (3.20%).

Participants with BE and TM were five in number, those with BE and TP were seven, and BE with both TP and TM were 6. Those who had only buccal exostoses and no tori were two in number. The distribution of tori is shown in Table 1. Among the 624 participants with tori, 280 (44.9%) were males and 344 (55.1%) were females. The male-to-female prevalence ratio for TP was 1:1.40 (M = 203, F = 278) and for TM was 1:0.68 (M = 25, F = 17) and that



Figure 6: Mandibular tori – band like

of participants with both TP and TM was 1: 0.94 (M = 52, F = 49).

Table 2 outlines the age distribution of the participants and tori. The mean age was 40–49 years with ages ranging from 5 to 85 years. A maximum number of tori 156 (24.67%) were found in participants with ages ranging from 20 to 29 years. The youngest participant with a torus was 5 years old and the oldest participant was 85.

The relationship between ethnicity, gender, and tori is shown in Table 3. Of the 624 patients who showed positive findings for tori and exostoses, 49.8% were Indian, 27.24% were Chinese, 20.9% Malay, and 2% of mixed ethnicity. All of them showed a higher female predilection with respect to the presence of tori and exostoses.

TP was classified based on their shapes as flat, spindle shaped, nodular, and lobulated. According to the findings of the study, spindle-shaped TP was the most common, seen in 338 participants (58.08%) (F = 148 and M = 96), followed by flat TP seen in 118 participants (20.28%) (F = 77, M = 41). Meanwhile, 55 participants had nodular TP (9.45%) (F = 29, M = 26) and 71 had lobulated TP (12.20%) (F = 31, M = 40). A new classification of TM is suggested based on the morphologic appearance as nodular and band like [Table 4]. Nodular TM was more common, seen in 134 participants (93.71%) (F = 59, M = 75), and band-like TM was seen in only 9 participants (6.29%) (F = 7, M = 2) [Figures 1-6].

Discussion

Tori have long been known to exist. Tori are considered as exostoses and hence a natural occurrence and not a pathological entity.^[2]

Depending on their anatomic location, tori can be categorized as TP and TM.^[4] The TP is a bony protuberance in the midline of the hard palate, usually found in the

Table 1: Gender distribution of tori

Gender	Total number of patients with tori	TP	TM	Both
Males	280	203	25	52
Females	344	280	17	49
Total	624	483	42	101

Table 2: Relationship between age group, gender and tori

Age group	Total number of patients with tori n=624	TP only 481		TM only 42		Both 101	
		M	F	M	F	M	F
≤9 years	1		1	-	-	-	-
10-19	48	16	30	1	1	-	-
20-29	156	52	71	4	4	5	20
30-39	144	41	61	6	4	19	13
40-49	126	31	64	8	2	12	9
50-59	105	46	37	1	5	11	5
60-69	38	14	12	5	1	5	1
70-79	3	2	-	-	-	-	1
≥80 years	3	1	2	-	-	-	-
	624	203	278	25	17	52	49

Table 3: Relationship between ethnicity, gender and tori

Ethnicity	Male (%)	Female (%)	Total	% of tori	M:F
Indian	148 (52.8)	163 (47.3)	311	49.8	0.8:1
Chinese	68 (24.1)	102 (29.6)	170	27.24	1:1.5
Malay	60 (21.4)	71 (20.6)	131	20.9	1:1.18
Mixed	04 (1.4)	08 (2.3)	12	1.9	1:2
Total	280	344	624	100	

Table 4: Relation between gender and shapes of tori

Gender	TP				TM	
	Flat	Spindle	Nodular	Lobulated	Nodular	Band like
Males	41	96	26	40	75	2
Females	77	148	29	31	59	7
Total	118	338	55	71	134	9
	TP n=582				TM n=143	

mid-third. Sometimes, it can be so large anteroposteriorly that it can reach the incisive foramen and the posterior edge of the hard palate. It is usually symmetrical but can appear as an irregular rounded mass. The TM is a bony protuberance found on the lingual surface of the mandible. It is usually found opposite the premolars above the mylohyoid attachment. It can sometimes grow to a size that interferes with the free movement of the tongue.^[2]

The discovery of these exostoses usually occurs incidentally during a routine clinical examination, as they usually do not produce any symptoms, except in cases of significant growth or in edentulous patients, in which case they may hinder the construction of the prosthesis. Despite the numerous studies focused on tori, their origin is unclear; various possible causes are presented in the literature, but none of them are definitive. A certain prevalence

with respect to ethnic groups, gender, and age has also been observed. Its elimination in dentate patients cannot be justified unless it can be used clinically or as a filling biomaterial to correct bone defects that patients may suffer in some parts of their jaw area.^[7]

The prevalence of occurrence of the tori according to the study by Al-Bayaty *et al.*^[8] is 12.3%, very close to that of Bruce *et al.*^[9] with 14.6%, while Jainkittivong and Langlais^[5] showed their prevalence to be 26.9%.

The exact cause of the appearance of the tori is not clear. The most widely accepted theory today is genetics,^[5,8,9] but it has not always been possible to show the autosomal dominant nature of its appearance.^[10] Another cause is superficial injuries, or its occurrence as a functional response in individuals with well-developed chewing muscles,^[5,8] or in patients with abraded teeth due to occlusion. In the study conducted by Reichart *et al.*,^[11] they found a significant correlation between the incidence of the torus and the presence of abraded teeth in Thais, but not in Germans. In studies conducted by Sirirungrojying and Kerdpon,^[12] Clifford *et al.*,^[13] and Kerdpon and Sirirungrojying,^[6] they found a large relationship between the TM and parafunctional habits, which they did not find with the TP. As possible causes, other authors mention eating habits,^[8,9,12] states of vitamin deficiency or supplements rich in calcium, and also diet.

It is not easy to compare the range of ages provided in the studies that we have analyzed, since in many cases, they are not standardized and each author gives a different reference. According to a study by Bruce *et al.*,^[9] the average age experiencing the onset of tori is 34 years. According to Al-Bayaty *et al.*,^[8] the average age is 30.7 years for patients with TP and 39.2 years for those with TM. The appearance of TM is rare before the first decade of life. Apart from that, there is not much variation with respect to the age of the onset of TP.

It is most frequent for TP to appear in women than in men,^[10,14] and it is believed that there may be a dominant type linked to the X chromosome. As for the TM, some authors have found no significant differences between men and women in their studies, although in all of the studies, it was found to be more common in males.

The appearance of tori is more common in certain ethnic groups and like the Eskimos, Japanese and American Indians.^[15] According to the results of the conducted surveys, TP was commonly found in the German, Norwegian, Croatian, Thai, and Malaysian populations; meanwhile, TM dominated in the Japanese, Spanish, and Ghanian populations.^[16]

Various methods employed for the determination of ethnic origin include both metric and nonmetric assessments.

Tori are nonmetric traits that can be used to determine ethnicity. For example, computer programs have been developed which match certain craniofacial measurements with a database containing craniofacial measurements from osteological material of known ethnicity. However, the assessment of nonmetric traits may be more subjective, as they cannot be discretely quantified, but rather reflect the training and experience of the investigators in identifying and recording these traits.

In a study conducted by Sejrsen *et al.* in 2005, three nonmetric cranial traits, namely palatal shape, palatine torus, and mandibular torus, were recorded in the jaws, in which the standards of the Arizona State University Dental Anthropology System were used for registration. The results showed that the dental nonmetric traits provided a good basis for deciding ethnicity or provenance.^[17]

According to the studies carried out by Singh *et al.* (2017)^[10] in a Malaysian population, oral tori/exostosis were noticed with a prevalence rate of 33%. It was also seen that the prevalence of TP was higher in females (35%) when compared to their male counterparts (20%). Similarly, in another study carried out by Mohd *et al.*,^[18] the prevalence rate of tori was found to be 38%, with the TP being significantly more predominant in females than in males (39.64% vs. 33.94%). We found the results from our study to be similar to the above-mentioned studies.

A diverse morphological variation can be seen: the TP can be flat, nodular, lobular, or spindle shaped, and the TM is usually nodular, unilateral, or bilateral and single or multiple.^[8,11] In the study conducted by Haugen,^[19] the most common shape was small and nodular; in most cases, the more voluminous TP were nodular, whereas the lobular shapes were more rare. In the study by Al-Bayaty *et al.*,^[8] in the majority of cases (48%), the most common shape for TP was flat.

In most cases, the finding is usually incidental and observed during the clinical examination at the dental office. This is because they are asymptomatic for the most part, and those who have torus are not aware of it.^[8] Sometimes, patients may present phonatory disturbances, limitation of masticatory mechanics, ulcerations of the mucosa, food deposits, and prosthetic instability, and some patients may experience cancerophobia and consult a professional to look for a solution.

Removal of the tori is not always necessary. The most frequent cause of extirpation continues to be the need for prosthetic treatment or that of being a potential source of autogenous cortical bone for grafts in periodontal surgery, cyst surgery, or implant surgery,^[20] although long-term stability of the grafts is uncertain.

Most authors do not recommend the removal of tori except in very extreme cases, and they recommended the removal of the prosthesis in these areas or the use of soft acrylics on the edges of the prosthesis. We can now avoid their removal while offering patients another alternative for rehabilitating the jaw by means of a prosthetic implant.

Barker *et al.*^[21] suggested that prosthodontic considerations should include the harvesting of the tori for augmentation procedures. Exostoses are an ideal site for harvesting as the surgery results in no anatomical or aesthetic deficit. Mandibular tori have been successfully used for onlay bone grafting on the buccal aspect of the mandible, prior to implant placement.

Conclusion

A high prevalence of tori was seen in the population studied. This was found to be consistent with the results of other studies carried out in Malaysia. Although harmless in most cases, in certain circumstances, their presence necessitates changes in denture design, of which the dentist should be mindful.

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Conflicts of interest

There are no conflicts of interest.

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