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Epidemiological aspects of oral tori in a Ghanaian community

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Aim: To determine the prevalence of oral tori, commonly found among Ghanaians, and compare with that in other regions. **Method:** Dental examination records of all 926 patients seen from January 1998 to April 2000 in a dental outpatient clinic in Accra, Ghana, were studied. The existence of a torus had systematically and routinely been ascertained by visual inspection and palpation. **Results:** Frequency distribution and cross-tabulation analysis showed an overall prevalence of 14.6 % with a female: male ratio of 1.1: 1. The most prevalent variety was the bilateral mandibular torus (12.1%) and the midpalatal torus of the maxillary tori (4.3 %). Females had 2.2 times the probability of having midpalatal torus compared to men (Odds Ratio (OR) = 2.2; Confidence Interval: 1.05, 4.70). There was a very strong concurrent relationship between mandibular and maxillary tori (OR = 16; CI = 7.8, 32.5). **Conclusion:** Comparisons indicated a strong similarity between torus prevalence in Ghana and the Caribbean regions. This should help in further discussions on the epidemiology of this bony anomaly.

Key words: Oral tori, epidemiology, diastema, Ghana

Oral tori have been defined as slow growing, osseous outgrowths at the midline of the hard palate and at lingual surfaces of the mandible¹. In the mandible the tori can be bilateral or unilateral, usually in the premolar regions but infrequently also at the genial tubercles. The torus is considered a developmental anomaly and has been termed an 'exostosis', a benign hyperplastic overgrowth of the bony surface to differentiate it from a true neoplasm. It presents either as a smooth bulging of the bone surface continuous with the adjacent area or as discrete, multi-locular, spherical projections with a broad base that forms a nodular cluster.

In some individuals the exostosis occurs in the jaw bone itself as irregular, lobular sections of the dense bone which blends with the adjacent cancellous trabeculae. These types are usually seen in the posterior buccal and palatal alveolar bone region in the maxilla adjacent to the upper permanent molars¹. Several factors affecting the development of tori have been proposed, the major factors being: genetics^{2,3}, environmental factors and masticatory stress (heavy grinding)^{3,4}, 'marine diets' and the number of existing teeth⁵. Hence studies among the Inuit (Eskimo) have found these populations to have a higher prevalence of tori than other races^{6,7}.

Although tori are commonly found among Ghanaians (West African coastal country) there have been no prevalence studies either from Ghana or from equatorial

Africa. A few studies, however, have been carried out among American blacks^{8,9} and in the Caribbean region^{10,11}. This study was therefore undertaken with the expectation that the traditionally coarse Ghanaian diets, usually accompanied by heavy masticatory stresses, together with its coastal marine diets, should provide tori prevalence data comparable to other regions like the Caribbean.

Method

Dental examination records of all patients seen from January 1998 to April 2000 in a private dental practice in Accra, Ghana, were studied and analysed. For this study, thorough routine dental examinations were done by the author for each patient where all oral conditions were systematically recorded. The existence of a torus was ascertained both by visual inspection and palpation noting the site or location on the jaw bone.

For diagnosis, torus mandibularis (mandibular torus) was defined as a benign, bony outgrowth or exostosis, unilateral or bilaterally, situated on the lingual aspect of the lower jaw. Torus palatinus (midpalatal torus) was similarly defined as a raised bony exostosis along the suture line in the midline of the hard palate. Noted was the other variety of non-sutural maxillary torus, which occurs on the alveolar ridges of the upper jaw. The size and shape of the torus was not considered and any questionable torus was classified as absent (no torus). All ages were determined with January 1998 as the reference point and rounded off to the nearest six months.

Data were entered in Excel and analysed using SPSS Windows (Version 7). Frequency distributions were obtained for variables under study and appropriate χ^2 studies were done.

Results

The total population studied

totalled 926 with 411 (45 %) males and 515 (55 %) females. A few patients, however, did not know their ages and the analyses with age groups were therefore based on a population of 899. The mean age was 34 years (SD 16.4) with the ages ranging from 1–81 years. There was no significant age difference between the sexes ($p = 0.16$).

The youngest age at which a torus was noted was at 11 years. Tori were observed across a wide age range, from 11–72 year-olds. Generally the prevalence of oral tori increased with increasing age (X^2 : $p = 0.009$; *Table 1*). The prevalence increased from 0.7% at age 1–14 years, peaked to 29.1% at age 40–49 years and then decreased to 9.7% at the 60+ age group (*Table 1*).

The different types of tori

The prevalence of all types of tori in the sample was 14.6 % in 135 individuals (*Table 2*). The most prevalent were the bilateral mandibular tori in 101 individuals (10.9%) and the mid-palatine torus of the maxillary tori in 36 individuals (3.9%).

Some individuals concomitantly had two or more different tori e.g. some patients with maxillary alveolar exostoses also had midpalatine tori and or a mandibular torus. In the mandible all three types were mutually exclusive.

Mid-palatal tori

In the study, 3.9% of the population had midpalatal tori with significantly more females (5.2%) than males (2.2%) exhibiting the trait (X^2 ; $p = 0.012$) (*Table 3*). Females had 2.2 times the probability of having midpalatal tori compared to males. (Odds ratio: 2.22; Confidence Interval (CI) = 1.05, 4.70). The youngest person with a maxillary torus was 19 years of age and the oldest was 65 years. Whereas the prevalence of the midpalatal torus started from age 15–19 years peaking at age 30–39 years (27.8%) (*Table 1*), the maxil-

lary alveolar exostoses started at age 20–29 years and peaked at a later age of 50–59 years.

In the maxilla 1.0% of the patients had the alveolar exostosis variety (*Table 2*). Of the nine maxillary exostoses observed five were concurrent with midline palatal tori and four had no accompanying midpalatal torus.

Mandibular tori

The youngest age with a mandibular torus was 11 years and the oldest was 72 years. In the total population the mandibular torus was the most prevalent with 12.1% (112 patients). The bilateral variety was the most prevalent of the mandibular tori (10.9%) (*Table 2*).

The mandibular tori formed 83% of all tori types with a prevalence of 12% and 12.2% in female and males respectively. The bimanibular variety was equally split at 10.9% in both sexes. There were fewer unilateral right mandibular tori (2 patients) compared with the left unilateral type (9 patients). Both unilateral right mandibular tori were in females. In the left unilateral variety four were in females and five in males.

Sex and tori

Although not a significant difference, more females (15.1%) than males (13.9%) developed tori with a female to male ratio of 1.1 : 1. In *Table 3* the prevalence of all types of tori was higher in females than males (except in maxillary exostoses) but the only significant gender differences were in the maxillary and the midpalatal tori ($p = 0.012$).

Most common sites – mandibular tori

The most prevalent site for mandibular tori was in the cuspid-first to second premolar region (19.6%) followed closely by cuspid to first bicuspid region (18.8%) and then the first and second bicuspid

Table 1 Distribution of tori by age

Age (yrs)	(n) % Age group/Tori	Total popn. in age group	Mandibular tori	Midpalatal tori
1–14	(1) 0.7	117	(1) 0.9%	0
15–19	(2) 1.5	48	(2) 1.8%	(1) 2.8%
20–29	(28) 20.9	207	(19) 17.0%	(9) 25.0%
30–39	(32) 24.6	205	(28) 25.0%	(10) 27.8%
40–49	(39) 29.1	176	(32) 28.6%	(10) 27.8%
50–59	(18) 13.4	73	(17) 15.2%	(3) 8.3%
60–80	(13) 9.7	73	(13) 11.6%	(3) 8.3%
Total	(134*) 14.9	899	(112) 12.1%	(346) 3.9%

* One age missing.

Table 2 Frequency distribution of types of tori

Total population with tori	(135) 14.6%
Total mandibular tori	(112) 12.1%
Bilateral mandibular tori	(101) 10.9%
Unilateral – Left side of mandible	(9) 1.0%
Unilateral – Right side of mandible	(2) 0.2%
Total maxillary tori	(41) 4.3%
Midpalatal (sutural) tori	(36) 3.9%
Maxillary alveolar exostoses	(9) 1.0%
Concurrent presence of mand./max. tori	(27) 2.9%

Table 3 Distribution of the different types of tori by sex

Torus type	% females with (total popn. = 515)	% males with (total popn. = 411)
All tori types (135)	(78) 15.1	(57) 13.9*
All mandibular tori (112)	(62) 12.0	(50) 12.2
All maxillary tori (41)	(29) 5.6	(12) 2.9
Midpalatal tori (36)	(27) 5.2	(9) 2.2
Bimandibular tori (101)	(56) 10.9	(45) 10.9
Mand./max. concurrent tori (27)	(17) 3.3	(10) 2.4
Maxillary exostoses (9)	(4) 0.8	(5) 1.2

* NS = No statistical significance

Table 4 Common sites for tori mandibularis

Cuspid to second bicuspid region	(22) 19.6%
Cuspid to first bicuspid region	(21) 18.8%
First/second bicuspid region	(18) 16.1%
First bicuspid region	(10) 8.9%
Lateral to first bicuspid region	(7) 6.3%
Lateral to second bicuspid region	(6) 4.5%

region (16.1%). The other sites were relatively less prevalent (*Table 4*), including two individuals who had tori from the central incisor to the first permanent molar region.

Discussion

In this study mandibular tori were found to be the most common of the oral tori. This agrees with the findings of Haugen in Norway¹², where the mandibular torus was also more predominant. In studies

from other geographic regions, however, the midpalatal torus was the most common^{11,13,14}.

In Ghana more females than males showed the trait for tori with female: male prevalence ratios of 1.1:1 (all types) and 2.4:1 (midpalatal tori). The exception was the mandibular tori where slightly more males than females showed the trait with a female: male ratio of 0.98:1 (*Table 3; Figure 1*). Interestingly, this slight decrease in prevalence of the

mandibular tori in females, although not statistically significant, has similarly been observed in other regions like the West Indies^{10,11} and Thailand¹³.

There was a highly significant co-morbidity relationship between mandibular and midpalatine tori ($X^2: p=0.000$) with an odds ratio (OR) of 16.0 (CI: 7.8, 32.5). Of the 36 individuals who had midpalatal tori, 63.9% had mandibular tori whereas of the 112 who had mandibular tori 20.5% had midpalatal tori. The very high odds ratio indicates that those with midpalatal tori were 16 times more likely to have mandibular tori compared to those who did not have the trait.

Although it appears later than the mandibular torus, the maxillary torus reaches its peak (26.8%) in the same age group of 30–39 years as the mandibular tori (44.6%). Men with midpalatal tori had twice the probability of also having a mandibular torus compared to women (OR for men = 29; OR for women = 14). Individuals with maxillary tori had a slightly higher probability of also having mandibular tori (OR = 20; CI: 9.7, 39.4) compared to those who did not.

Other craniofacial conditions of dental significance were observed concurrent with the tori. Strong relationships were noted between oral tori and prevalence of diastema mediale. The probability of having a median incisal diastema in those with midpalatal torus was noted to be 4.8 times (CI: 2.3, 9.8) whereas those with concurrent mandibular and maxillary tori had a 6.2 probability of also having a diastema. These relationships remained significant even when sex was controlled. Of the 135 individuals who had tori 28.9% had diastema mediale whereas 31.7% of the 123 with diastema had tori ($X^2: p = 0.000$; OR = 3.4). This shows a strong tendency for either condition to affect the occurrence of the other and may indicate a polygenic relationship.

The overall prevalence of tori (14.6%) in Ghana was relatively low in comparison with findings from

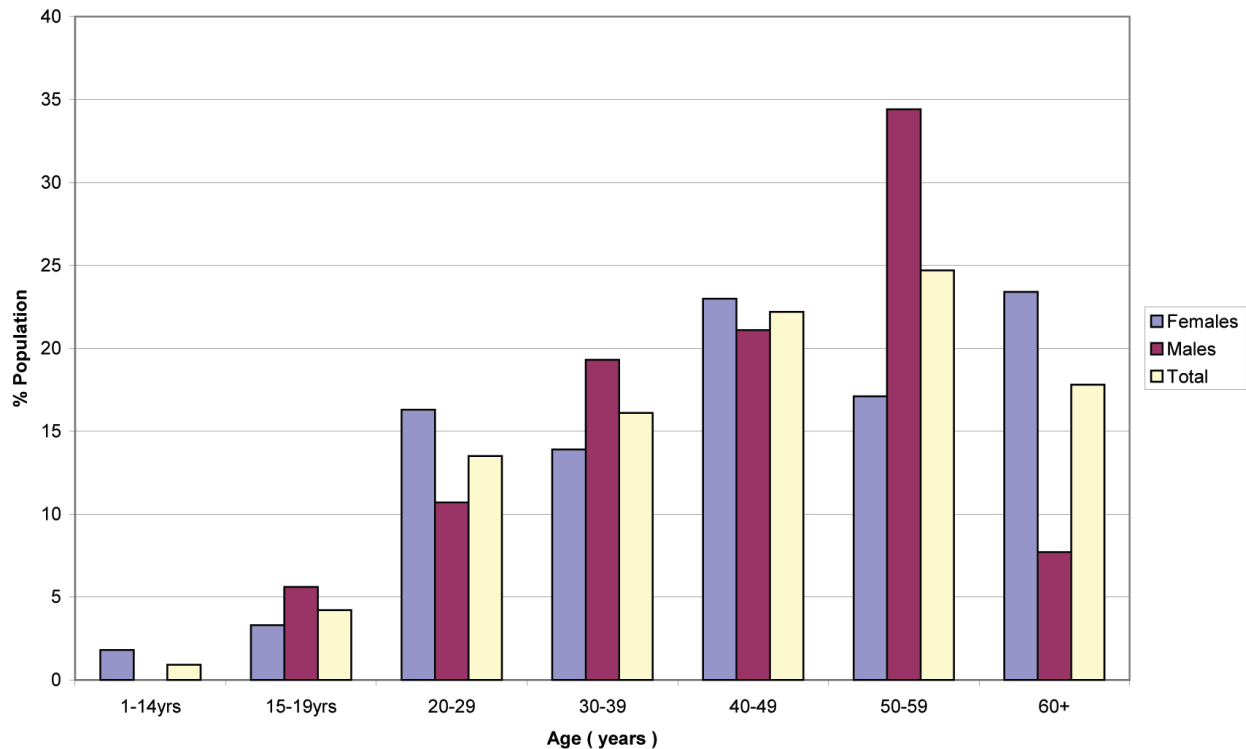


Figure 1. Distribution of tori by sex and age.

Table 5 Comparing prevalence of tori by type and sex with female/male ratios in Ghana and the West Indies²⁰

Country	Sex (n)	%Total with tori	Midpalatal tori	Mandibular tori	Midpal/mand tori
Ghana (2002)	F (515)	57.8	75	55.4	63
	M (411)	42.2	25	44.6	37
	F/M	1.1 : 1	2.4 : 1	0.98 : 1	1.4 : 1**
	Overall prevalence	14.6	3.9	12.1	2.9
West Indies (2001)	F (426)	67	75	47	68
	M (241)	33	25	53	32
	F/M	1.1 : 1	1.7 : 1	0.4 : 1	1.2 : 1**
	Overall prevalence	12.3	6.6	2.8	2.8

Norway¹² and the United States^{8,9} where prevalence varied from a low of 23% to as high as 43%. It was, however, quite similar to findings in the West Indies^{10,11} (12.3%) and London (UK)¹⁴ (13.5%). These variations in prevalence in different regions have been ascribed to differences in gene pools, varying environmental influences predominant in these regions or a combination of both. Although diets in Ghana and the West Indies may appear to be comparable, it is difficult to think of similar factors operating in London (UK), unless the sample contained a significant number of these ethnic groups.

Table 5 shows close similarities between Ghanaian and West Indian tori experience. In both regions the female: male prevalence ratio was 1.1 : 1. Analysis of variance showed no significant differences between the tori experience in Ghana and in the West Indies (Table 5). Generally, there were more similarities than differences, the most obvious being the difference in the mandibular tori prevalence where 12.1% Ghanaians versus 2.8% West Indians exhibited the trait. In both regions, however, more males than females had mandibular tori.

In this study population the cuspid-first bicuspid-second bicus-

pid region was the most prevalent site for mandibular tori (54.5%; Table 3). Two female patients who complained of difficulty with speech had very extensive, bilateral mandibular tori from the centrals to the first permanent molar regions. These huge tori formed a bony bed on the floor of the mouth and severely displaced and crowded the tongue.

The youngest person with a torus (midpalatal) was in the <10 year age group in the West Indian¹¹ study whereas torus mandibularis was observed in the youngest age in Ghana in a 11 year old. The torus/age distribution depicts a condition that appeared around the

first decade, increased and peaked in the fourth decade and then decreased in the over 60 year age group (Table 1; Figure 1). A similar pattern in the age distribution has been observed in other studies^{12,13,15,16} where tori were observed to be more prevalent in the middle phase of life than at the younger or older groups. This age distribution pattern appears to support the observation that tori may not be permanently fixed, inert anomalies but are in fact dynamic, capable of growth and are subject to intermittent resorption and remodelling. It should, however, be emphasised that present data is cross-sectional and this observed age effect is not directional or longitudinal as if in a cohort study. Until a cohort is followed in future studies to document the behaviour of tori with increasing age the observed relationship with age remains hypothetical.

Several factors have been found to affect the development of tori, the main ones being genetics, heavy overload of masticatory or chewing forces and marine diet²⁻⁴. It has therefore been suggested that the generally decreasing ability to chew and absorb food in the elderly may result in decreased occlusal forces and malabsorption of nutrients, resulting in loss of bone mass. The possibility of genetic determination whereby the progression or regression of oral tori could be switched on and off as a result of the decrease in grinding ability with increasing age has also been proposed^{3,4}. These factors could possibly affect the behaviour of oral tori and explain the observed inverse relationship with age.

The determination that oral tori may serve as a reservoir of minerals for positive bone homeostasis with increasing age may also help explain the observed decrease in prevalence in old age. Oral tori have been found to favour bone mineral homeostasis in the elderly^{17,18}. Bone mineral density (BMD) has been observed to

decrease with age^{17,18} and a higher bone density has been found to be related to lower incidence of osteoporotic fracture in the aged. Of the absolute amount of mineral in bone (BMC), 90 per cent is obtained by the end of adolescence with peak bone mass reached before the age of 30 years¹⁷. As one ages past 35 years, the amount of bone deposited starts to slightly lag the amount of bone resorbed, leading to a gradual decline in bone mass in the older population. In a recent study¹⁹, subjects (both males and females) who had mandibular tori were found to have a more positive bone balance and a higher bone mineral density compared with those who did not have tori. Presence of tori at young adulthood has therefore been suggested as a marker of increased BMD and an indication of a lower risk for developing osteoporosis in the future¹⁹. Moreover, the lack of statistical significance of age effects on tori among the sexes (Table 3) discounts the possibility of oestrogen-mediated mechanism. Suggested future studies should follow populations with oral tori to determine the behaviour of the tori as the population ages. This observation will then confirm the hypothesis that oral tori could be dynamic, capable of growth and may be subject to resorption and remodelling processes^{3,4}.

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