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Torus palatinus and torus mandibularis: A review of the literature

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Abstract

The torus has been mentioned in the literature for about 180 years. However, little has been revealed about it until the last two decades when great advances were made in the field of genetics. Its occurrence in various ethnic groups ranges from 9 to 66 per cent.

Even between similar ethnic groups living in different environments, different figures have been reported. It has been statistically proven that differences do occur between various ethnic groups and the sexes.

In current thinking, the occurrence of tori is considered to be an interplay of genetic and environmental factors. The quasi-continuous genetic or threshold model seems to hold the answers to their formation. This theory proposes that the environmental factors responsible must first reach a threshold level before the genetic factors can express themselves in the individual. Hence, both genetic and environmental factors determine liability, making the system multifactorial.

Key words: Torus mandibularis, torus palatinus, prevalence, morphogenetics.

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Introduction

The torus palatinus and torus mandibularis have long been known to anthropologists. The earliest article appeared in 1814 written by Fox.† The tori are considered as exostoses and hence a natural occurrence and not a pathological entity. The function of the tori is questionable; in fact, it seems a hindrance. It obscures radiographic details of lower premolars and the maxillary sinus. From a prosthetic standpoint, it hinders construction and function of both upper and lower dentures. It may even affect speech, deglutition and mastication.

Investigations have frequently been hampered by two opposing views, that is, whether tori are due to genetic or environmental factors. Only recently has a more elaborate, dynamic theory been developed which is able to account for many of the contrasting observations and apparently incompatible interpretations of the past.[1] Another question is whether the two tori share a common morphogenetic background or represent separate biologic units. The literature in this field is scant and the results contrasting. It has long been known that there is a racial difference in occurrence of tori. However, even within the same race living in different environments, figures vary considerably. Methodologic deficiencies and shortcomings may be partly responsible, such as ill-defined criteria for selection of materials and classification, doubt about ethnic representation, insufficient sample size and unsuitable methods.

Types of tori

The *torus palatinus* is a bony protuberance in the midline of the hard palate, usually found in the mid-third. Sometimes, it can be so large antero-posteriorly 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. Woo[2] has described one variant on the hard palate which consisted of two equal elevations running antero-posteriorly, separated by a deep median grove.

The *torus mandibularis* 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.

Woo[2] has described a torus maxillaris as a hyperostotic formation on alveolar portions of the maxilla. These appear as little uneven tuberosities on the lingual side and may extend to the canine. However, a more appropriate term for this is multiple exostoses, as described by Shafer *et al.*[3] It must be noted that Shafer described it being found mostly on the buccal region in living subjects in contrast to Woo who used skulls.

Mucosa

The mucosa covering these bony protuberances is usually thin but normal looking. However, it can

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occasionally look blanched. Ulcerations can occur if the bony protuberances are traumatized.

Roentgen examination

Radiographically, both tori appear as radiopaque masses, often obliterating details of the teeth and the maxillary sinus. For a large torus palatinus, the spongy layer appears as a less dense radiopaque mass compared with the compact layer.

Histology and development

In cross-section studies on skulls with tori palatini,[4] three layers can be seen. They are the nasal compact layer, the intervening spongy layer, and the oral compact layer. In a torus palatinus, there is an overgrowth of the oral compact layer and the spongy layer, though it is debatable whether the overgrowths of these two layers are in proportion. Maximum hypertrophy of these two layers is always seen at the location of the mid-palatine suture. In small tori, the spongy layer may not be seen and a fusion of the oral and nasal compact layers can be seen. The torus mandibularis is seen as a lamellar periosteal outgrowth of the mandible. The spongy layer is present only if the torus mandibularis attains a large size.

The nasal compact layer remains at the same thickness regardless of whether a torus is present or not. Added to this, the floor of the nasal fossa is flat even when a torus is present, confirming that a torus is formed due to a projection downwards of the diploe and not of the palatine process. This is caused by the continued activity of the embryonic osteoblasts which pile up at the palatal suture after the median palatal suture junction is completed.

Woo[2] has tried to relate the size of a torus palatinus to that of the shape of the arch, that is, the narrower palate has a larger torus and the broader palate has a smaller torus.

Microscopically, pressure lamellae are arranged anteroposteriorly. This direction is of interest since it is not in accord with the theory of the pressure of mastication.[5-7]

Classification

There have been numerous attempts to classify both the torus palatinus and the torus mandibularis. However, there has yet to be a satisfactory method. The torus palatinus can be classified by size, shape or location while the torus mandibularis can be classified by size or shape.

With regards to size, some authors[7,8] classify the torus as being trace, small, medium or large, while Haugen[1] omitted the category trace as he felt that the use of this term in doubtful cases led to highly diverging results. Haugen[1] did not base his classification on measurements as he felt that the torus was a non-metrical object but instead used a standard procedure of inspection to assess the different sizes. Woo's[2] classification of small, medium and large is derived from actual measurements, the scheme being shown in Table 1. In Woo's classification, if one of the measurements fails to meet the criterion of the medium or large grade, it is classified as of the smaller grade. However, in practice, height proved to be the determining criterion.

Table 1. Scheme for classification of the size of torus palatinus[2]

	Elevation (mm)	Width (mm)	Length (mm)
Small	Under 3	Under 10	Under 15
Medium	From 3-5	From 10-15	From 15-25
Large	Above 5	Above 15	Above 25

Hooton[9] classified the shape of the torus as being a ridge, mound or lump. A more popular classification of the shape is by Thoma[10] who classified them as being flat, spindle-shaped, nodular or lobular. The flat torus is a broad thickening with a flat, slightly convex smooth prominence. The spindle-shaped torus produces a ridge in the midline. The nodular torus consists of small protuberances which may unite to form a single swelling. The lobular torus is an overhanging growth due to continuous expansion.

Classification by shape is often difficult as there are many transitional forms and there is no clear dividing line. Difficulty always arises such as trying to distinguish between a spindle torus and a prominent palatine suture[11] even after manual palpation. Haugen[1] made no attempt at precise numerical registration as he believed that it was deceptive and misleading.

Chew[12] classified the torus by location. The palate was divided into an anterior, mid and posterior region and the location of the torus was noted by the segment or segments it occupied.

So few investigators have attempted to classify the torus mandibularis that the literature about the condition is scant. Haugen[1] classified their sizes into small, medium or large, using inspection. Thoma[10] distinguished four clinical varieties of torus mandibularis, but did not attempt to apply this classification. Instead they are classified in accordance with the number of bony nodes and their placement. Four categories apply: bilateral solitary, bilateral multiple, unilateral solitary, and unilateral multiple.

In torus palatinus, the flattened form predominates.[2,13-15] Torus palatinus of the lobular type was usually classified in the category of large.[1] For the torus mandibularis, the commonest forms in decreasing order are bilateral solitary, bilateral multiple, unilateral solitary, and unilateral multiple.[1] Together, the bilateral variants make up more than 90 per cent of tori.

Relationship between tori

A relationship between the occurrence of torus palatinus and of torus mandibularis was suggested by some[2,8] and opposed by others.[14,16] Haugen[1] in his study of 5000 patients found the occurrence of torus palatinus simultaneously with torus mandibularis was low, denoting a non-significant correlation. Still the analysis showed that each torus occurred more than twice as frequently in an individual bearing the other torus.

Sex

Although some authors found that the torus palatinus affected males more often,[7,15] most authors are in favour of the torus palatinus affecting females more,[2,13,14,17-19] and this is significant at the 0.1 per cent level[1] (Table 2). Also, it seems that the torus palatinus found in females

Table 2. Relation between sex and occurrence of torus palatinus

Investigator	Race	Total %	Male	Female
Woo[2]	Eskimos	66.0	62.6	69.9
Woo[2]	American Indians (USA)	55.0	50.0	59.4
Chew and Tan[12]	Chinese	48.0	48.0	48.0
Woo[2]	Mongolians	47.0	44.0	50.0
Vidic[17]	Yugoslavians	45.5	42.0	57.5
Woo[2]	White Americans (USA)	45.0	42.4	47.2
King and Moore[19]	Whites	37.5	28.0	47.0
Woo[2]	Black Americans (USA)	37.0	36.0	40.6
Keng and Ow[25]	Chinese	36.5	41.6	33.8
Hrdlicka[7]	Peruvians	30.5	37.0	24.0
Miller and Roth[18]	Americans (USA)	24.2	16.3	32.3
Kolas *et al.*[14]	Americans (USA)	20.9	14.7	26.7
Austin, Radford and Banks[13]	Black Americans (USA)	19.5	12.9	26.3
Bernaba[15]	Brazilian Indians	10.0	13.0	7.0
Haugen[1]	Norwegians	9.2	6.7	11.2

is of a larger size.[1,2] For the torus mandibularis, the opposite applied, being more prevalent in males than females[1,7,20] with only one exception[13] (Table 3).

Age

It is generally accepted that a torus develops within the first 30 years of life.[14,19] In a juvenile,[2] the incidence of tori is much lower, confirming this theory. However, in the literature, there are two cases, both aged 40, of a torus palatinus[21] and a torus mandibularis[22] developing for 11 and 30 years, respectively.

Incidence

As shown in Table 2, the incidence of torus palatinus between various races varies between 9.2 per cent to 66.0 per cent, while that for torus mandibularis varies between 0.5 per cent to 63.4 per cent (Table 3). It is interesting to note that figures obtained from skulls were always higher than those from living subjects. This is explained by the fact that small tori are more likely to be found in skulls than in living subjects when they are obscured by mucosa and mucous glands.[1,2] However, the sex difference for prevalence is smaller[2] for skulls. This could be due to the fact that smaller tori are found in males.

Aetiology

The cause of torus formation has been attributed to various factors by various authors. Some of these opinions are nutritional disturbances,[18] evolution,[2] heredity,[8] continued growth,[10,18] masticatory hyperfunction,[3,5,7] and environmental factors.[1,11,23]

Table 3. Relation between sex and occurrence of torus mandibularis

Investigator	Race	Total %	Male	Female
Hrdlicka[7]	Aleuts	63.4	51.6	32.7
Austin, Radford and Banks[13]	Black American (USA)	8.2	5.3	10.9
Haugen[1]	Norwegians	7.3	8.5	6.4
Bernaba[15]	Brazilian Indian	0.5	0.5	0.5

The best explanation seems to be an interplay of factors, these being genetic, environmental and masticatory hyperfunction. Eggen and Natvig,[23] using logistic regression, proposed that the presence of a torus was 30 per cent genetic and 70 per cent environmental. In studies done on Caucasians of similar stock living in different environments, a disparity in the presence of torus palatinus has been found[11,23,24] which cannot be explained by race alone.

There is evidence to show that the torus is more frequently observed in the middle phase of life.[1,18,23] This in turn indicates that the torus should be interpreted in terms of a dynamic phenomenon rather than as a stationary or progressively growing lump of bone. During the course of life, the torus responds not only to genetic factors but also to environmental and functional factors, particularly masticatory stress. This would explain the difference in the incidence of torus palatinus of only 36.5 per cent in edentulous patients,[25] compared with 48 per cent for both dentate and edentulous patients,[12] since edentulous patients would exhibit decreased masticatory stress.

Studies have given rise to the concept that genetic factors not only affect the size but also the morphology of the torus.[26] The quasi-continuous genetic or threshold model best explains the occurrence of tori.[27,29] According to this theory, the torus is caused by an interplay of genetic and environmental factors, with a threshold value beyond which an individual will be affected.

Treatment

Most tori are managed conservatively. Most of the time, only patient reassurance is needed. However, in certain cases where the torus has become so large that it interferes with speech, mastication, deglutition, and the fitting of a denture, surgical intervention would be needed. Cases of associated osteomyelitis[30] and squamous cell carcinoma have been reported[31] and are best treated by their respective methods.

Conclusion

Summing up, it can be said that although the situation is far from being clarified, much has been uncovered in recent years. It is known that the torus is an exostosis formed by hypertrophy of the compact layer and sometimes the spongy layer. The classification of the torus is far from satisfactory because of the many intermediate forms found. The difference between the sexes and various ethnic groups has been statistically proven. No relation has been found between the torus palatinus and torus mandibularis so far. Between similar ethnic groups living in different environments, there is a difference in the incidence of the occurrence of tori. This is best explained by the quasi-continuous genetic or threshold model. The theory proposes that although the occurrence of tori is mostly genetic, it is also affected by environmental factors. If these environmental factors reach a certain threshold level, the individual would be affected. This theory is able to account for the many disparities, which have frustrated earlier investigators when they tried to apply their single-gene Mendelian theory to the occurrence of tori.

Many investigations have already been carried out on the occurrence of tori. It would be futile to conduct more

studies comparing the occurrence of tori between the sexes, different ethnic groups, and so forth. Instead, more investigations need to be conducted along the line of the quasi-continuous model. The genetic information presently known about the torus is just the tip of the iceberg.

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