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Torus palatinus and torus mandibularis as supplementary indicators in forensic human identification: a systematic review*

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Abstract

Background: Torus palatinus and torus mandibularis are benign bony outgrowths often discovered incidentally during dental examinations. While usually asymptomatic, they can hinder prosthetic treatments. Their distinct morphology, population-specific prevalence, and rarity make them potential markers for forensic human identification. Objective: This systematic review evaluates oral tori as distinctive traits in forensic applications, emphasizing their prevalence, morphology, etiology, and clinical and forensic significance. Methods: A literature search (2015–2025) was conducted in PubMed, Scopus, ScienceDirect, and Google Scholar following PRISMA guidelines. Eligible studies included original research, reviews, and case reports on oral tori or exostoses with forensic or epidemiological relevance. Non-English, animal-based, and treatment-focused studies were excluded. Additional relevant sources were reviewed to supplement the analysis. A total of 376 records were retrieved, and after screening and eligibility assessment, 36 studies were included in the review. Results: Oral tori exhibit variation across populations and sexes and are morphologically diverse, though they are typically small and asymptomatic. Their development is influenced by both genetic and environmental factors. While clinically benign, they can present challenges in prosthetic rehabilitation. Forensically, their population-specific patterns make them valuable non-metric traits, particularly when recorded in dental records to assist identification in the absence of primary markers. Conclusion: Oral tori serve as clinically relevant and population-specific traits that hold value in both dental care and forensic human identification

Keywords: torus palatinus; torus mandibularis; forensic odontology; forensic identification

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Introduction

The identification of human remains is a basic human right essential for legal, administrative, social, and psychological considerations. Identifying the deceased is a crucial part of resolving any case involving a person's death, whether in legal contexts such as criminal investigations (e.g., torture, abuse, murder) or civil matters (e.g., marriage, child custody, or inheritance) (1). The significance of identification, both legally and humanely, is highlighted by the recognition of an individual's right to identity in international humanitarian law and international human rights documents like the Universal Declaration of Human Rights (2).

Human identification is a primary objective in forensic science, where skeletal anatomical variations hold significant potential. These traits serve as secondary identifiers, supporting ancestry assessment and contributing to both reconstructive and comparative phases of personal identification (3). Non-metric skeletal traits are minor morphological variations with a genetic basis, though they can also be shaped by environmental and physiological influences. These traits include tubercles, accessory ossicles, foramina, sutural variations, and oral bony outgrowths such as oral tori or exostoses. Since they may resemble trauma on radiographs or skeletal remains, they must be carefully differentiated from antemortem, perimortem, or postmortem injuries (4).

Additionally, it plays a significant role in supporting the psychological well-being of the family. Initially, this procedure depends on distinct biological evidence that aids in distinguishing one individual from another, such as physical and genetic data obtained through a postmortem (PM) examination (1,5). Forensic odontologists are responsible for identifying skeletal remains especially in the maxillofacial area, examine external factors (like signs of surgeries or orthodontic appliances) as well as internal factors (like distinct features, anomalies, and anatomical variations) of the skeleton. These findings are then compared with antemortem (AM) data to establish a conclusive identification (5). In their routine analysis of skeletal remains, anthropologists document anatomical variations, including accessory foramina and tubercles, distinctive exostosis (tori), and vascular grooves. These features, as indicated in their standard procedures, may serve as potential individualizing markers.

Examining the skull is a key step in developing the biological profile of unidentified skeletal remains, as it can provide important information for identification. When the remains are too fragmented or incomplete for precise measurements, anthropologists rely on the skull's shape and other observable features. Characteristics from other bones can also assist, particularly when postmortem findings are compared with antemortem X-rays. In their analysis, anthropologists record anatomical variations such as extra openings (foramina), small bony projections (tubercles), unusual exostosis (tori), and vascular grooves, that may serve as distinctive markers for identification (5).

Oral tori are benign bony growths that form through hypertrophy of cortical bone, and sometimes spongy bone. A palatal torus occurs along the midline of the palate at the cruciform suture of the maxilla, while a mandibular torus develops on the lingual or vestibular surfaces of the mandible. Tori are nonneoplastic, nonpathological, and grow slowly over time. Usually discovered during routine clinical examinations or occasionally by patients, they are considered normal anatomical variations that rarely require treatment. Their distinctive morphology, however, can aid in the identification of unknown skeletal remains (6–8). The uniqueness of tori, not present in everyone, can serve as an identifying characteristic that distinguishes one individual from another. This condition is highly valuable in forensic identification, as it provides distinctive features of an individual during the victim identification process. There are several forensic identification cases where tori have aided investigations as one of the markers for identifying individuals. Considering the scarce scientific literature available on tori despite their common occurrence and lack of pathological significance, our objective is to conduct a comprehensive review focusing on tori as potential biomarkers for human identification within the field of forensic odontology.

Methods

Article selection

The inclusion criteria for this review were: (I) original research, review articles, or case reports; (II) studies addressing oral tori or oral exostoses; and (III) articles with a forensic focus, or, if not forensic, studies discussing oral tori in contexts such as prevalence, etiology, morphology, and related aspects.

Exclusion criteria were: (I) case reports without forensic relevance; (II) articles not published in English; (III) theses or dissertations; (IV) studies

involving animals; and (V) studies focusing on the treatment of torus.

Search strategy

The reviewers conducted the study in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Relevant articles were retrieved from PubMed, Scopus, ScienceDirect, and Google Scholar (Figure 1) using the keywords “torus palatinus,” “torus mandibularis,” “oral exostoses,” and “forensic identification.” The search was limited to English-language publications from 2015 to 2025. All references were imported into Mendeley, where duplicates were identified and removed using the software’s duplicate-check function and further verified manually by two independent reviewers. The same reviewers screened titles and abstracts to determine eligibility for inclusion in the review. Additionally, the reference lists of included articles were examined to identify any relevant studies not captured through the database searches. Several additional supporting sources were also consulted to complement the review.

Results

The database search (Scopus, PubMed, ScienceDirect, and Google Scholar) initially identified 376 articles (Fig. 1). After removing 66 duplicates and 16 records for other reasons, 294 articles remained for screening. Title and abstract screening excluded 238 articles, leaving 57 for full-text retrieval. Of these, 14 could not be retrieved, and 43 were assessed for eligibility. Five reports were excluded at this stage due to insufficient data (n = 3), treatment-focused content (n = 2), or irrelevance to the research question (n = 2). Ultimately, 36 studies met the inclusion criteria and were included in the review

Morphology

Tori, deriving from the Latin word for "to stand out" or "lump," refer to exostosis characterized by elevated cortical bone density and a small quantity of bone marrow. They are covered by a thin and poorly vascularized mucosa. A torus histologically comprises augmented layers of compact and cancellous bone encased by a thinly vascularized mucosal layer of limited vasculary (9). Studies of torus palatinus in both archaeological and modern populations date back to the 1800s, with torus mandibularis examined nearly as extensively. Recording the frequency of these bony growths is now a standard part of bioarchaeological inventories and has been widely applied in population studies (10).

A torus palatinus (TP) is a solid bony growth located along the midline of the palatine suture. Although it may occur at any age, it is most often observed in the second or third decade of life. Its size and shape can vary over time, with four main morphological types: flat, spindle-shaped, nodular, and lobular. Flat tori present as smooth, broad-based growths typically symmetrical along the median raphe, while spindle-shaped tori appear as a raised ridge on the palatine suture, sometimes with a central groove. Nodular tori consist of multiple distinct protrusions that may partially merge but maintain grooves between nodules, whereas lobular tori are larger, with several lobes connected by a single wide base. Among these, flat and spindle-shaped tori are the most frequently observed (11).

Torus mandibularis (TM) is a benign bony outgrowth that commonly develops on the lingual surface of the mandible in the premolar region, above the mylohyoid ridge. It is bilateral in roughly 90% of cases, most often presenting as firm, rounded nodules that may be solitary or multiple (12). Typically asymptomatic, slow-growing, and self-limiting, mandibular tori can occur in both dentate and edentulous individuals. While usually harmless, in some cases they may enlarge to several centimeters, potentially interfering with prosthetic appliance use (13). Most measure less than 2 mm and may appear unilaterally or bilaterally, as single or multiple nodules. Larger lesions can take on a multilobulated form, and in rare cases, contralateral tori may meet at the midline, forming “kissing tori” (14). Radiographically, TM appears as a dense, radiopaque mass overlapping the roots of the canine, premolar, or molar teeth (15).

Kalaignan et al. proposed a grading system for torus palatinus and mandibular torus based on their shape, size, and prominence to improve clinical evaluation. In a sample of 72 patients, torus palatinus was far more prevalent, most commonly lobular in form, followed by spindle, flat, and nodular types. Its dimensions showed wide variation in length and width but limited variation in height, enabling a structured classification that could help assess its impact on denture stability and retention. In contrast, mandibular torus was observed in only a few cases, mostly of mild to moderate prominence, which limited the applicability of the grading system in this region. Despite this limitation, the study provided a practical framework for dental practitioners, particularly prosthodontists, to

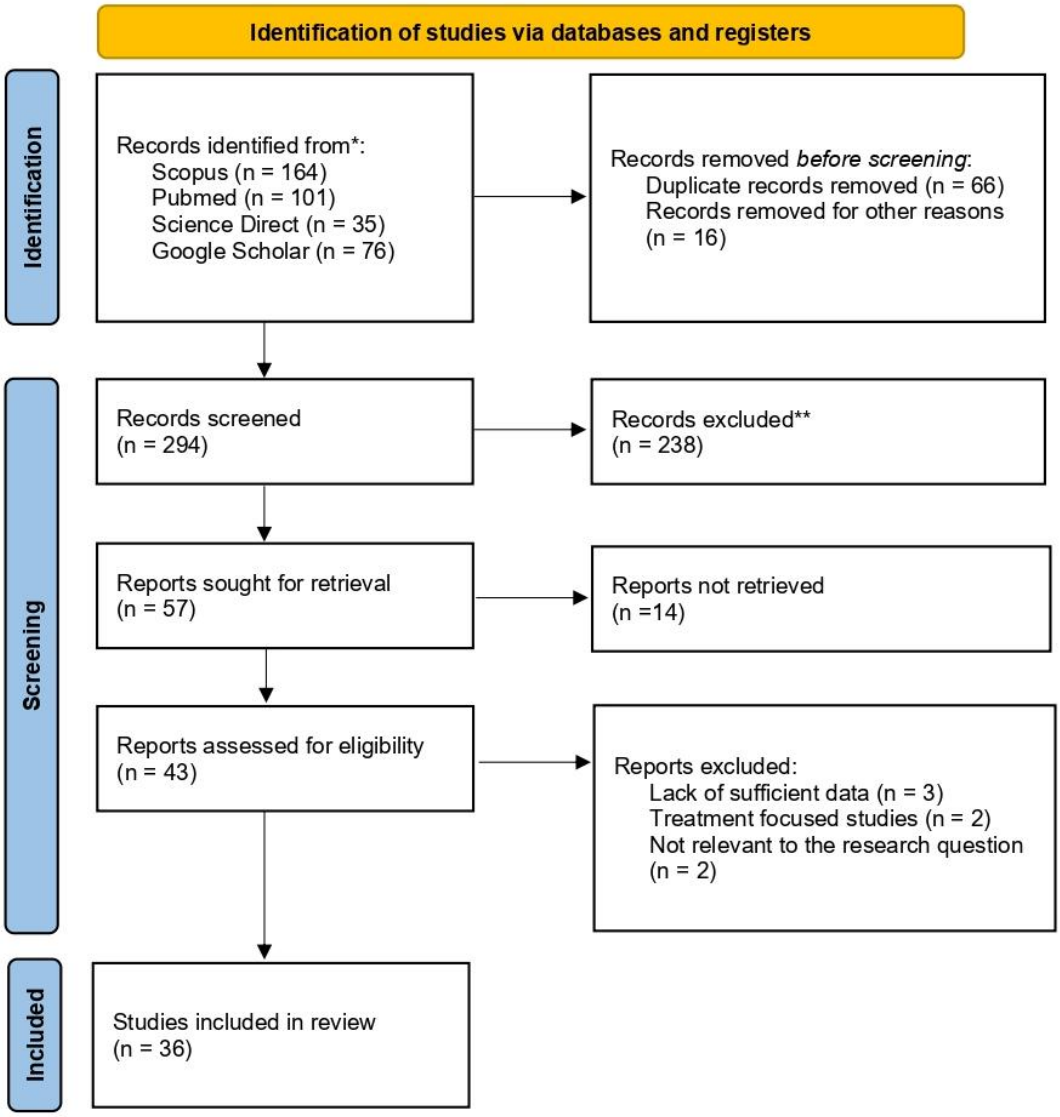

Figure 1. PRISMA flow diagram illustrating the process of study identification, screening, inclusion, and exclusion for the systematic review.

assess the relationship between tori and prosthesis design, laying the groundwork for further research in this area (16).

Prevalence

The size of torus palatinus often increases with age, and its prevalence varies across populations, being more frequent among Asians but relatively uncommon in most African and European groups (4). One of the earlier modern studies, conducted in Thailand by Jainkittivong et al., reported that both mandibular and palatal tori appeared most frequently in the third decade of life (20–29 years). This suggests that in the Thai population, these bony growths tend to emerge in early adulthood, contrasting with later-onset prevalence observed elsewhere (17).

In Malaysia, Kumar Singh et al. found a prevalence of 33% in their study population. Palatal tori were more common in females, while mandibular tori and buccal exostoses were more often observed in males. They also noted ethnic variation, with Malawian patients showing higher rates of palatal tori compared to Chinese and Indian groups (18).

Also in 2017, Morita et al. conducted a cross-sectional study among Hiroshima University students in Japan. Among 204 young adults

(mean age 22.4 years), mandibular tori were identified in 58.3%. The study further showed that dental attrition and occlusal contact area were significantly associated with the presence of mandibular tori, suggesting that mechanical stress plays a key role in their early development (19).

A larger study in Malaysia by Telang et al. in 2019 screened 4,443 patients and reported that 14% had oral tori. Of these, 10.8% presented with palatal tori and 0.9% with mandibular tori. The highest prevalence was seen among young adults aged 20–29 years (24.7%). Palatal tori were most frequently nodular (59%), while mandibular tori were predominantly nodular (89%) or band-like (15%), the latter being described for the first time. Size ranged from 0.5 to 5 cm. The authors suggested that dietary and environmental factors may influence both the age distribution and morphological variation (20).

Sergani et al. in 2020 analyzed a large multi-ethnic cohort of 1,102 adults from European, West African, and East Asian ancestries. They found that females had a significantly higher prevalence of palatal tori across all groups. Among females, East Asians showed the highest rate (34.7%), followed by Europeans (24.9%) and West Africans (15.2%). In males, no significant ethnic differences were observed. Interestingly, palatal shape differences were associated with the presence of palatal tori in Asians and Africans, where individuals exhibited a shorter and wider palate. These findings emphasize both sex and ancestry as important factors influencing prevalence (21).

Maduakor and Nwoga reported the prevalence of TP and TM among 3,000 Ibo-speaking individuals in South-East Nigeria. A total of 292 subjects (9.7%) presented with tori, showing a strong female predominance (88%). Isolated TM was most frequent (56.8%), followed by concurrent TM and TP (25.7%) and isolated TP (17.5%). Peak occurrence was noted in the fifth decade of life. No significant associations were found between age, sex, and type of tori. While consistent with other Nigerian studies, these prevalence rates differ considerably from those of other ethnic populations (22).

Most recently, Wilson et al. in 2025 examined 1,242 patients in Mississippi and found a prevalence of 24.4%. Of these, 303 individuals had maxillary or mandibular tori. Females were more frequently affected (57.4%) than males (42.6%), and prevalence was highest in Caucasians (71.3%), followed by African-Americans (23.8%) and Asians (5%). The mean age of affected patients was 56 years, and prevalence increased with age (17).

Alzarea investigated the prevalence of torus palatinus (TP) and mandibular torus (TM) among 847 edentulous Saudi patients aged 51–79 years in 2016. Clinical examination revealed that 17.6% of subjects presented with tori, with 7.8% showing TP and 9.8% TM. The highest occurrence (36.4%) was noted in individuals aged 60–69 years, and prevalence was slightly higher in males (19.0%) than females (15.9%). Morphologically, flat-shaped TP (57.6%) and bilateral solitary TM (39.8%) were the most common forms. While no statistically significant sex or age differences were observed, the study highlighted a comparatively higher prevalence of tori in this population, emphasizing its relevance in prosthodontic and periodontal treatment planning (23).

These studies demonstrate that oral tori are widespread but differ greatly in prevalence, morphology, and demographic patterns across populations. Southeast Asian studies (Thailand, Malaysia, Japan) often report higher prevalence in younger adults, while American data show an age-related increase. Multi-ethnic research highlights sex differences, with females consistently showing higher rates, and ancestry-specific variation, with East Asians having the highest prevalence of palatal tori. These findings suggest that both genetic and environmental influences, such as occlusal stress, diet, and craniofacial morphology, play critical roles in shaping the occurrence of tori worldwide.

Etiology

The etiology of torus palatinus and torus mandibularis is considered multifactorial, with roughly 30% attributed to genetic influences and about 70% to environmental factors. Hereditary contributions include autosomal inheritance patterns, sex chromosome involvement, and genetic mutations such as LRP5, SMAD9, and Notch3, which affect bone density and osteogenic activity. Environmental influences are mainly linked to mechanical stress, particularly occlusal pressure from biting, clenching, or bruxism, as well as dietary habits, nutritional status, and medications affecting calcium metabolism. Medical conditions that affect bone metabolism, such as hyperparathyroidism, have been linked to the development of tori (24). Together, these genetic and environmental factors interact to influence the development of oral tori (8,25). Bruxism is a parafunctional habit that manifests in three forms: daytime teeth

clenching, nocturnal grinding, and the less common rhythmic tapping of teeth. Individuals with bruxism are reported to be about four times more likely to develop oral tori compared to those without the condition (26).

The formation of torus mandibularis is thought to represent buttressing bone growth in response to occlusal trauma, serving as a functional adaptation to reinforce trabeculae under stress. Mechanical loading stimulates bone remodeling, where mild loads maintain normal remodeling, while higher loads trigger hypertrophy or, if excessive, woven bone formation. Bone morphogenic proteins (BMPs) released during bone flexion may further promote osseous growth, leading to thickening or exostoses in stressed regions. Excessive occlusal forces, particularly from the palatal facets of maxillary teeth onto the lingual aspects of mandibular teeth, are proposed as the main etiological factor, linking torus mandibularis to increased masticatory stress and parafunctional activity (27). Supporting this, Khan et al. reported the first case in Pakistan of concurrent torus palatinus, bilateral torus mandibularis, and maxillary buccal exostoses in a 22-year-old female, suggesting a possible link to abnormal occlusal stresses and supplementation with calcium and vitamin D (28).

Genetic factors play a significant role in the etiology of oral bony outgrowths (OBOs), including tori, as evidenced by twin studies showing high heritability ($h^2 = 0.658$) and strong monozygotic concordance (9). At the molecular level, dysregulation of WNT signaling, particularly through mutations in LRP5 or LRP6, drives excessive bone formation, with tori and exostoses presenting as benign outgrowths of membranous bone. Case reports linking high bone mass phenotypes to LRP5 and AMER1 mutations, alongside contributions from PTH and mTORC1 pathways, further support this mechanism. Overall, OBOs reflect a multifactorial etiology where genetic predisposition, mediated by bone regulatory pathways, interacts with environmental and functional factors to shape their development (25,29,30).

FREM2 variants, previously associated with Fraser syndrome, have been identified in heterozygous form in patients with craniofacial anomalies, including oral exostoses, mesiodens, and supernumerary teeth, suggesting a direct genetic contribution. Similarly, rare heterozygous variants in the WNT ligand secretion mediator (WLS) gene, which regulates both canonical (β-catenin–dependent) and non-canonical WNT signaling, have been observed in patients with dental anomalies, some presenting with torus palatinus or mandibularis. Disruption of these pathways highlights the role of genetic dysregulation in bone growth and remodeling, reinforcing the multifactorial basis of tori development (31,32).

Bezamat et al conducted a family-based genome-wide association study in individuals affected by torus palatinus and their unaffected relatives in the Philippines. By analyzing 3,519 SNPs via transmission disequilibrium tests, they found that several genetic markers showed suggestive associations with torus palatinus. Notably, the SNP rs6582285 in the CAPS2 gene was highlighted: the C allele appeared protective against torus palatinus compared to the T allele. Other genes implicated included GRTP1 and PLPPR1, which are involved in protein transport and other cellular functions. Although none of the associations met stringent multiple-testing correction, results support a multifactorial inheritance model for torus palatinus and suggest genetic variation plays a meaningful role in its etiology (33).

Zambrano-de la Peña et al. reported the case of a 25-year-old female with a unilateral mandibular exostosis confirmed through cone-beam computed tomography, alongside a nodular torus palatinus at the midline of the palate. Clinical signs included wear facets on tooth 46 and thickening of the periodontal ligament space, both indicative of occlusal trauma. This case underscores the multifactorial etiology of mandibular exostoses, where genetic predisposition, parafunctional habits such as bruxism, and occlusal stress all contribute to their development. The absence of systemic conditions such as Gardner's syndrome further supported the diagnosis of localized exostosis. This highlights the importance of considering both hereditary and mechanical factors when evaluating tori and exostoses in clinical and forensic contexts (34).

Clinical implication

The detection of tori typically happens unexpectedly during a regular medical check-up since they often don't cause any noticeable symptoms, except when they grow significantly or in individuals without teeth, potentially posing difficulties in making dental prosthetics. The presence of tori can obstruct the depth of the lingual vestibule, preventing the proper seating of prefabricated impression trays. This bony anatomical variation may lead to trauma and pain during the impression-making process, given the

thin and easily traumatized soft tissue covering. Due to their harmless nature, surgical intervention is typically unnecessary unless tissue trauma, periodontal issues, or prosthodontic complications arise. However, there have been case reports of exostoses removal due to difficulties with intubation, prosthetic concerns, limited tongue movement, or obstructive sleep apnea (9).

Mendes da Silva et al. highlighted the clinical significance of mandibular tori, which, while often asymptomatic, can complicate dental procedures by interfering with prosthetic rehabilitation, speech, and in some cases, surgical intubation, occasionally requiring surgical removal. Their study demonstrated that mandibular tori are linked to functional alterations of the stomatognathic system, including masseter EMG hyperactivity, increased bite force, and reduced temporal muscle thickness. The authors emphasized the need for further research to explore variations across facial morphology, age, and sex, and to clarify whether stronger muscular activity predisposes individuals to torus development (35).

Oral torus as forensic identification tool

Human identification in cases involving burned or heavily decomposed remains poses a significant challenge in forensic anthropology, particularly in regions with limited resources and high rates of violence. Traditional methods of identification, such as dental records or DNA analysis, may not always be feasible under such conditions. In these contexts, the study of non-metric cranial traits, such as the mandibular torus or other oral exostoses, can provide valuable supplementary information. These features, which are often population-specific and show considerable variation in prevalence, may serve as useful markers for comparison with antemortem clinical or dental data. Therefore, epidemiological studies documenting the frequency and distribution of non-metric traits are essential, as they expand the pool of traits available for forensic comparison and enhance the reliability of identification processes when other methods are unavailable or inconclusive (7).

The application of cranial non-metric traits in biological profiling and human identification remains a subject of debate among forensic anthropologists, with no clear consensus reached. However, recent studies have supported their potential usefulness, particularly traits such as the palatine and mandibular torus, in forensic casework. Collecting epidemiological data on these traits across different populations is essential, as it strengthens the reliability and scope of forensic anthropological analyses and enhances the value of forensic reports. In forensic anthropology, a thorough understanding of non-metric traits is crucial for distinguishing normal anatomical variations from pathological changes, since certain traits may resemble skeletal diseases or traumatic injuries. In some cases, personal identification requires multiple approaches, as standard identifiers like DNA, fingerprints, or dental records may be unavailable. Validated non-metric traits could serve as useful alternatives, especially when primary markers are lacking, such as in edentulous individuals where dental data are limited (5,36).

Oral torus for forensic sex determination and age estimation

Torus palatinus, a bony outgrowth located in the midline of the hard palate, has been studied across populations due to its clinical and anthropological significance. Its prevalence often shows sex-related variation, with many studies reporting a higher frequency in females. Research on North Indian skulls evaluated palatine torus development for its potential role in sex determination, using regression models for statistical analysis. The findings indicated that palatine torus could correctly classify sex in about 48% of cases, suggesting limited reliability. While not a strong standalone marker, its correlation with other craniofacial indices highlights its potential as a supplementary feature in sex determination when combined with additional skeletal traits (37).

The mandibular torus has been proposed as a potential age indicator, as its development is influenced by prolonged mechanical stimulation from occlusal forces. Studies in Japan have shown that older adults tend to present with more prominent tori compared to younger individuals. Moreover, the frequent detection of mandibular tori during denture fabrication further supports their higher prevalence in older population. Recent evidence supports the use of mandibular tori as potential age-related markers. Mizuno et al, in 2024, in a large-scale study of 2,792 Japanese corpses using postmortem CT, demonstrated a clear association between mandibular torus thickness and age. Thickness increased progressively across decades, with regression analysis confirming significant age-related changes after adjusting for sex, body size, and occlusal status. The effect was most

pronounced in males with preserved occlusal contact, highlighting the influence of mechanical loading on torus development (38).

These findings suggest that measuring torus thickness, in combination with occlusal status and sex, can improve the accuracy of age estimation in forensic identification. For instance, individuals over 30 years typically exhibited torus thickness above 4 mm, while those over 40 often exceeded 8 mm. Exceptionally thick tori (>10 mm), though rare, may also serve as distinctive personal identifiers (38).

Lease highlighted the close relationship between dental wear, oral tori, and age estimation. Analysis of 504 skulls showed that dental wear and tooth loss, more than age, sex, or ancestry, strongly influenced the presence of mandibular and palatine tori as well as oral exostoses. Parafunctional activities such as bruxism and clenching, along with masticatory forces, accelerate dental wear and are positively associated with tori development, with men showing higher frequencies of mandibular tori when heavy wear is present. Since dental wear naturally increases with age, its interaction with occlusal stress contributes to tori formation, suggesting that these bony outgrowths may serve as useful adjuncts in forensic age estimation (10).

Discussion

Morphological skeletal traits reflect individual variability and are crucial in the personal identification of unknown remains by comparing antemortem (AM) and postmortem (PM) data. Forensic anthropologists rely on these distinctive markers to establish whether the remains correspond to a specific missing individual. Non-metric traits are inherent skeletal variations that manifest as tubercles, accessory ossicles, foramina, sutural variations, and oral bony outgrowths such as oral tori or exostoses, often with unclear function or origin. Unlike metric traits, which can be measured quantitatively (e.g., length or diameter), non-metric traits are assessed qualitatively, typically recorded as present or absent, or evaluated according to their degree of expression. These traits, including oral tori and exostoses, are of particular interest in anthropology and forensics, as they can provide insights into genetic background, population differences, and personal identification (39).

Within the broader spectrum of cranial non-metric traits, oral tori like torus palatinus and torus mandibularis, are relatively uncommon bony outgrowths, with prevalence generally lower than traits such as mastoid foramina, which appear in over 90% of crania, compared to fewer than 40% for palatine tori. This relative rarity, especially when expression is pronounced or accompanied by other exostoses, enhances their discriminatory potential. Unlike smaller sutures or foramina, tori offer the advantage of clinical detectability, as they are often documented in dental records, radiographs, CT scans, or during denture construction, enabling direct antemortem–postmortem comparison. Furthermore, their impact on speech, mastication, prosthetic rehabilitation, denture fitting, or surgical procedures increases the likelihood of clinical reporting, making them valuable complementary markers in forensic human identification (7,39).

Limited research has explored using torus morphology to identify unidentified skeletal remains. However, there's a notable case reported by Gupta et.al. where the distinct shape of a torus palatinus helped identify a missing woman. A forensic anthropologist studied the skull, determining the deceased likely a Black woman between 35 and 50 years old. Examination revealed she lacked teeth, had a right TMJ issue, and a unique torus palatinus. Police found only one missing person matching this description, a middle-aged Black woman who disappeared after her house fire in 2007. Investigations at the fire scene revealed a denture, a hammer, and an abuse-related journal. Forensic odontologists compared the skull's torus palatinus with the denture, noting a perfect match in shape. The denture also matched her dental records, confirmed by her dentist who mentioned her torus palatinus surgery in 2005, explaining the unique shapes. Later searches found more remains, reinforcing the identification. The torus palatinus' unique shape and the denture played a key role in confirming the identity, resolving the mystery after seven years (11). Variations in bone structure across individuals can assist in identifying unidentified skeletal remains.

A key limitation in using non-metric cranial traits such as torus mandibularis and torus palatinus for forensic human identification is the limited availability of antemortem (AM) comparison records, including CT scans and detailed dental records. In high-resource settings, where advanced imaging and thorough dental documentation are increasingly common, these materials could provide valuable references for comparison. However, in low-resource contexts, such records are often scarce, restricting the

applicability of this approach. Moreover, the absence of robust population-specific reference databases further limits the ability to assess the true individualizing potential of these traits. While torus mandibularis and torus palatinus represent promising supplementary markers, broader data collection and standardized documentation are essential before they can be routinely integrated into forensic identification practices (39).

For dental identification to be effective, dentists are legally and professionally obligated to maintain accurate and comprehensive records of their patients. Such documentation not only reflects the quality and thoroughness of care but also serves as critical evidence in court proceedings and forensic investigations (40). Hence, dental practitioners must meticulously record all clinical details, including anatomical variations like oral tori, which can play a significant role in both treatment planning and forensic identification. Since tori occur infrequently in the general population, their precise documentation may provide distinctive markers that enhance the reliability of personal identification. In this way, comprehensive dental records support both clinical practice and medico-legal processes, offering valuable contributions to forensic science and law enforcement efforts. However, tori should not be regarded as primary identifiers for forensic purposes. Instead, they function as secondary identifiers, best applied in conjunction with established methods such as dental treatments, genetic markers, or other cranial traits. Used in this integrative way, tori can add supportive value by combining their anatomical distinctiveness with available clinical documentation, thereby strengthening the overall process of forensic human identification.

Conclusion

The presence of anatomical variations in oral region, such as torus palatinus and torus mandibularis plays a potentially valuable contribution in identifying unidentified skeletal remains. While tori are not considered primary identification tools, their distinct morphology and relatively low prevalence make them valuable comparative features for supporting individual identity. Therefore, thorough documentation of oral anatomical variations, including tori, in comprehensive dental records becomes essential for dental practitioners. These records not only aid in precise treatment planning but also serve as distinctive markers in forensic and medico-legal contexts. In forensic settings, this should be complemented by systematic photography during autopsy and the inclusion of such findings in standardized postmortem forms, ensuring reliable antemortem–postmortem comparison and strengthening their utility in human identification.

Declarations of interest

None.

Author contributions

AHRA contributed to conceptualization, data curation, formal analysis, investigation, methodology, resources, software, validation, visualization, witing – original draft, writing – review & editing. EIA contributed to conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, supervision, validation, visualization, writing – review & editing

Statement on the use of artificial intelligence in manuscript preparation

Artificial intelligence was used during the preparation of this manuscript solely for grammatical correction and language polishing. Specifically, ChatGPT was used to improve sentence structure and grammatical accuracy. All core ideas, data analysis, and the original drafting were performed entirely by the authors.

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