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Entoconulid or Cusp 6 on Indonesian Male Body: A Forensic Odontology Case Report

انتوكونوليد أو الحدبة السادسة على جثة ذكر إندونيسي: تقرير حالة في طب الأسنان الشرعي

Anna Nur Azizah[1], Arfiani Ika Kusumawati[2], Mindya Yuniastuti[1], Elza Ibrahim Auerkari[1]*

[1]Department of Oral Biology, Faculty of Dentistry, University of Indonesia, Jakarta, Indonesia

[2]Department of Forensic Medicine and Medicolegal, Said Sukanto Bhayangkara Police Hospital, Jakarta, Indonesia

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Abstract

Dental morphological variations, such as the entoconulid or cusp 6, hold significant value in forensic identification and anthropological studies. These traits often vary across populations and provide insights into genetic and evolutionary patterns. The entoconulid is an uncommon dental trait observed primarily in Mongoloid and African populations. It reflects complex genetic, epigenetic, and environmental interactions during tooth development. In forensic contexts, the presence of such morphological features can aid in population-specific identification and provide additional evidence in cases lacking ante-mortem data.The entoconulid, though rare, is a significant morphological characteristic with applications in forensic identification and anthropological research. Dentists should recognize and document such traits to support the identification of human remains, especially in the absence of other identifiers. This article will disscuss about a 21-year-old deceased male that was involved in a gang fight and was referred to Said Sukanto Bhayangkara Police Hospital in Jakarta for postmortem examination. Extraoral findings included multiple abrasions and fractures on the body, while intraoral examination revealed dental caries, unerupted teeth, and the presence of entoconulid on tooth 46.

Keywords: Forensic sciences, entoconulid, sixth cusp, case report, forensic odontology.

المستخلص

تعتبر الاختلافات المورفولوجية السنية، مثل الحديبة الإضافية أو الحديبة السادسة، ذات قيمة كبيرة في تحديد الهوية الجنائية والدراسات الأنثروبولوجية. غالبًا ما تختلف هذه الصفات بين المجموعات السكانية وتقدم رؤى حول الأنماط الوراثية والتطورية. الحديبة الإضافية هي سمة سنية غير شائعة تلاحظ بشكل أساسي في المجموعات السكانية المنغولية والإفريقية. وهي تعكس تفاعلات وراثية، فوق جينية، وبيئية معقدة أثناء نمو الأسنان.

في السياقات الجنائية، يمكن أن يساعد وجود هذه السمات المورفولوجية في تحديد الهوية الخاص بالسكان وتوفير أدلة إضافية في الحالات التي تفتقر إلى البيانات السابقة للوفاة. الحديبة الإضافية، على الرغم من ندرتها، هي سمة مورفولوجية مهمة لها تطبيقات في تحديد الهوية الجنائية والبحث الأنثروبولوجي. يجب على أطباء الأسنان التعرف على هذه السمات وتوثيقها لدعم تحديد هوية الرفات البشرية، خاصة في غياب معرفات أخرى. سيناقش هذا المقال حالة ذكر متوفى يبلغ من العمر 21 عامًا كان متورطًا في شجار عصابات وأحيل إلى مستشفى شرطة سعيد سوكانتو بهايانجكارا في جاكرتا لإجراء فحص ما بعد الوفاة. شملت النتائج خارج الفم كدمات وكسور متعددة في الجسم، بينما كشف الفحص داخل الفم عن تسوس الأسنان، والأسنان غير المنبثقة، ووجود الحديبة الإضافية على السن 46.

الكلمات المفتاحية: علوم الأدلة الجنائية، النتوء المخروطي الداخلي، الحديبة الإضافية، الحديبة السادسة، تقرير حالة، طب الأسنان الجنائي.

* Corresponding Author: Elza Ibrahim Auerkari
Email: eiauerkari@yahoo.com

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1. Introduction

Variations in dental structures have long been a subject of interest for forensic scientists, both from theoretical and applied perspectives. The majority of morphological variations are observed in the tooth crown, with some occurring frequently across populations, while others are distinctive to specific ethnic groups. Although human dentition follows a fundamental structural framework, individual differences arise due to the expression and intensity of primary and secondary dental traits, which collectively reflect an individual's genetic makeup. Teeth exhibit both morphological and metric variations, which can differ within and across populations while adhering to the general anatomical blueprint of human dentition. Additionally, rare dental anomalies, primarily influenced by environmental factors during development, constitute a secondary category of dental variations, which hold significant evolutionary implications [1,2].

The occlusal surface of permanent mandibular molars exhibits a morphology that ranges from a square to an elongated oval shape in the mesiodistal direction. Four principal cusps are usually symmetrically positioned along the tooth's main axes in first molars. These cusps resemble maxillary molars in that they are arranged in lingual and buccal aspect. The mesiolingual (metaconid cusp) and distolingual (entoconuid cusp) are the two main lingual cusps, when the mesiobuccal (protoconid cusp) and distobuccal (hypoconid cusp) are the two conspicuous buccal cusps. Mandibular molars are distinguished by the presence of a smaller fifth cusp, and in some cases, a sixth cusp. Located distally to the hypoconid, the fifth frequently observed cusp is the hypoconulid [3,4].

Although it is more frequently found buccally adjacent to the hypoconulid, in certain teeth it is situated closer to the buccal-lingual midline. The entoconulid, a little cusp situated between the entoconid and the hypoconulid, is usually the extra cusp when there are six. The groove between the buccal and lingual cusp rows splits into two branches that curve around the hypoconulid in the shape of a Y, a configuration also referred to as the Y-5 pattern formed by the cusp separation grooves [5,6].

In forensic odontology, teeth play a crucial role in forensic identification by providing insights into a person's age, sex, and race (ancestry) through dental morphology and development. Age estimation is based on tooth eruption patterns in children and wear, pulp chamber size, and dentin translucency in adults. Sex determination relies on dimorphic traits such as larger canine size and robust mandibular features in males. Ancestry (race) identification is inferred from dental traits like shovel-shaped incisors in East Asians and Native Americans, Carabelli's cusp in Europeans, and high molar cusp numbers in African populations, and more traits include amount of cusp teeth like entoconulid. The purpose of this article is to describe an instance of "Tuberculum Sextum," commonly referred to as the "Entoconulid" or "Cusp 6," that was found on the body of a deceased Indonesian man and correlation to forensic odontology aspect [6,7].

2. Case report

On Friday, September 20, 2024, Said Sukanto Bhayangkara Police Hospital, Jakarta received a referral from RSUD Bekasi for the body of a 21-year-old male who died after being involved in a gang fight. The body will be examined to determine the exact cause of death.

On extraoral examination, rigor mortis was found throughout the body and was easily resisted. fractures were found in the lower 1/3 of the left femur and palpable fractures in the mid pubic bone. wounds were found on the back, there were several

abrasions with the largest size of 6 x 2 cm and the smallest size is 0.5 x 0.5 cm, in the right inner thigh folding area, there were abrasions measuring 3 x 1 cm, on the outer right thigh 10 cm above the knee fold there were abrasions measuring 11 x 2.5 cm, on the right thigh on the front side 13 cm below the front of the intestine bone there was an open wound with uneven edges accompanied by a tissue bridge with a 11 x 2.5 muscle tissue measuring 5 x 7 cm.

On intraoral examination in Fig.1 shows misaligned mandibular maxilla teeth condition when occlussion, Fig.1a. Teeth 18 and 28 are fully erupted and there are caries in teeth 18, 16, 26, 27, and 28, Fig.1b. In the mandible, tooth 38 has not erupted, and tooth 48 is in the partial eruption stage. There are caries 37, 36, 45, and 47 in Fig.1c. When observed in tooth 46, there is variation in the number and shape of the cusp called the entoconulid, Fig.1d.

Figure 1- a. *Maxilla and mandible anterior teeth shows misalignment,* **b.** *lingual aspect shows caries profunda on 36 and caries media on 46,* **c.** *palatal aspect shows ovoid maxillary arch,* **d.** *tooth 46 shows entoconulid*

3. Discussion

Forensic odontology plays a role identification. Primarily identification from DNA, fingerprint and teeth. Secondly, through the analysis of dental records or property characteristic from the body. Fingerprint and DNA analysis are two other critical methods used in forensic identification, and they complement the information provided by forensic odontology [8].

Fingerprints are unique to each individual, making them a reliable method for identification. Even identical twins have different fingerprints. Fingerprints can be preserved on various surfaces and are often collected from crime scenes. Forensic experts analyze the patterns, ridges, and minutiae of fingerprints to match them with known samples. In cases of severe decomposition or damage, fingerprints may not be retrievable [8,9].

DNA profiling is highly specific and can match biological samples to individuals with great accuracy. Like fingerprints, DNA is unique to each person (except for identical twins). DNA can be obtained from various sources such as blood, saliva, hair, and other bodily fluids. It is particularly useful in identifying victims from remains or in sexual assault cases where biological materials are present. DNA extraction, amplification (using techniques like PCR), and sequencing or matching against databases is involved in the process. DNA testing can take more time than fingerprint analysis and may require sufficient biological material to yield clear results [8,9].

Based on the fingerprint and DNA limitation, forensic odontologyst use dental records to match and identify victims in cases of mass disasters, accidents, or crimes where bodies may be disfigured or unrecognizable. The unique structure of teeth can provide critical information for establishing identity, similar to fingerprint analysis. Teeth can give clues about a person's age, as specific dental

characteristics change with age. Certain dental traits, such as tooth shape and size, shovel shape and morphology cusp can be analyzed to determine the sex and race from unidentified individuals [8,10].

Permanent mandibular first molars typically feature five cusps: mesiobuccal, distobuccal, centrobuccal, distolingual and mesiolingual. However, some molars may have only three or four cusps. In three-cusped forms, both the distobuccal and distolingual cusps are missing, and in four-cusped molars, the distobuccal cusp is absent. The sixth cusp can only be identified when all five other cusps are present. It is not possible to determine if a single distal cusp represents cusp 5 or cusp 6 without the presence of two distinct distal cusps to differentiate them [6,11].

In 1970, Turner introduced a standard reference plaque to classify the varying expressions of this trait, known as the Arizona State University Dental Anthropology System (ASUDAS), as detailed in Table 1. In this case, the entoconulid has a score of 2 when the cusp 5 is larger than cusp 6 [6].

In a forensic context, entoconulid analysis can be used for individual Identification by comparing dental morphological patterns, including the presence of entoconulid, between recovered tooth samples and dental records of missing individuals, forensic experts can aid the identification process. The distribution of entoconulid varies among different populations. For example, some studies show that the frequency of entoconulids is higher in certain populations compared to others. This information can help in estimating the geographical or ethnic origin of unidentified human remains [6,8,11].

The entoconulid in mandibular molars was studied by Townsend et al. in relation to its expression and genetic basis. In a geographically remote population of Aboriginal people from Australia's Northern Territory. Four classes of trait expression were hypothesized after analyzing the dental casts of 399 patients. These classes included trace, small, medium, and large entoconulid cusps. The incidence rates in the permanent dentition vary from around 50% on mandibular second molars to 70% on first molars and as high as 80% on mandibular third molars. In comparison, the frequency of entoconulid occurrence exceeded 80% in primary mandibular second molars. Only 3% of primary second molars exhibited large cusps, whereas 25% of permanent mandibular third molars displayed this characteristic. The degree of expressiveness rose along the molar teeth distally [12–14].

Table 1- *Entoconulid description and score based on ASUDAS terms.*

Score	Description of cusp 6 expression
0	Cusp 6 expression is none/absent.
1	When cusp 6 expression compared to cusp 5, cusp 6 is substantially smaller.
2	Cusp 5 is larger than cusp 6
3	Cusps 6 and 5 are the same size
4	When cusp 6 expression compared with cusp 5, cusp 6 is bigger
5	Cusp 5 is slightly less than Cusp 6.

Epithelial-mesenchymal interactions mediated by signals shared with different organs mediate the formation of individual teeth. During epithelial morphogenesis and the formation of tooth forms, mesenchymal gene expression and cell proliferation are regulated by a number of members of the fibroblast growth factor (FGF) family, specifically FGF 4, 8, and 9 [15,16].

Kettunen et al. conducted a study in the development a mouse teeth, which they examined the functions of FGF-3, FGF-7, and FGF-10. According to their findings, FGF-3 and FGF-10 appear to have variably regulated expression and serve redundant roles as mesenchymal signals controlling tooth epithelial development. Furthermore, FGF3 might

take part in the primary enamel knot's signaling processes [16].

Another explanation for the differences in molar occlusal surfaces is that they are polygenetically determined by a combination of alleles on two or more sites and are brought on by terminal enamel deposition in one of the final stages of molar growth. Several studies have demonstrated that the X chromosome's genes control enamel deposition, whereas the Y chromosome's genes affect cell division linked to dentine–enamel bond formation and enamel deposition.Throughout the lengthy process of dental development, complicated multifactorial interactions between genetic, epigenetic, and environmental factors result in dental abnormalities [17,18].

The cusp counts of 392 Japanese male and female first and second molars did not significantly differ, according to a study by Suzuki and Sakai. In comparison to Aleuts (21% and 18%) and Eskimos (22% and 18%), 65% first molar and 63%, second molar, Cusp 6 was found to be approximately three times more prevalent in Indian Crania. Nonetheless, the percentage of cusp 6 (20%) in the mandibular first molars of Aleuts and Eskimos was comparable to our findings. Each of the three populations (Aleuts, Eskimos and Indian) had five until six cusped primary lower molars. There were no four-cusped molars discovered. The most prevalent ethnic groups with four-cusped second lower molars are, Indians (3%), Aleuts (9%) and Eskimos (1%) [19,20].

The current paper's author has conducted a few studies on various dental morphological characteristics, such as metric and non-metric tooth characteristics that make up the crowns and roots of pediatric patients in India. Nagaveni et al. documented four instances of metaconulid or cusp 7 in the permanent lower first molars of individuals from Indiana. The existing body of research on this subject is relatively restricted. The author subsequently recorded the occurrence of "paramolar tubercle" in primary dentition in the year 2009. In 2012, Nagaveni carried out a further assessment to determine if additional roots were present in the permanent mandibular molars of Indian children [19,20].

A study using a quasi-continuous threshold model revealed that mandibular first molars had the most genetic contribution to the incidence of entoconulid variability. Molar characteristics on lower and upper teeth were found to be significantly related, implying that similar developmental pathways may be responsible for these traits. The distal occlusal aspect of molar, which experiences early wear during mastication in Aboriginal people, is given extra mass by the entoconulid and the metaconule [14].

Kharaisat et al. examined the expression of metaconulid, entoconulid, and pre-entoconulid and post-metaconulid traits on permanent mandibular first molars among the Jordanian population residing in the community, as well as the interactions between different characteristics in permanent mandibular first molars. The researchers examined 360 students between the ages of 15.5 and 16, 176 of whom were boys and 184 of whom were girls. Dental casts were created for these kids, and their dental traits were assessed. In mandibular first molars, approximately 15.83% of cusp 7 and 21.6% of cusp 6 were found. The Jordanian Arabs exhibited a significantly higher frequency of cusp 6 and 7 on their lower first molars compared to other Western Eurasians in the study. Consequently, the researchers deduce that there was considerable genetic mingling between the Middle East and Mongolians and Sub-Saharan Africans.Additionally, they proposed that the tooth morphological characteristics of cusps 6 and 7 have nothing to do with phenotype or genetics [6,21].

One racial trait of the Mongoloids has been

identified as the sixth cusp. It is claimed to exhibit clear demographic differences. According to reports, American Blacks exhibit the highest frequency, setting them apart from other groups. Therefore, to a certain degree, these dental abnormalities can be utilized to determine a person's origin [5,14,22].

4. Conclusion

Primary identification using dental examination is highly recommended, especially when DNA and fingerprint analysis are difficult to perform. One of the valuable dental traits in forensic identification is the entoconulid, which can serve as a distinctive feature for determining sex and ancestry across different populations. entoconulid, is easy to find in Mongoloids and Africans in the Middle East. Even if the presence of it is not linked to clinical issues, anthropologists and morphologists are very interested in it since it offers further study evidence regarding how to identify a person in a forensic case. Understanding normal dental variation is essential in forensic odontology, as it provides a crucial reference for accurate identification. Therefore, forensic odontology plays a significant role in recognizing individual characteristics through dental traits, contributing to a more comprehensive and reliable identification process.

Ethical Clearance

Ethical clearance has been approved by Faculty of Dentistry University of Indonesia, February 03, 2025 with registration No. I/KEPKG/FKGUI/II/2025. No identifiable information, such as names, addresses, or personal records, was included in the study. Additionally, photographs and dental records were handled in a manner that prevented any direct identification of individuals.

Conflict of interest

The authors declare no conflicts of interest.

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