Talon cusp in Malay primary teeth: expression, frequency, covariates and treatment needs

John R. Lukacs1*, Sri Kuswandari2

1Department of Anthropology, University of Oregon, Eugene, OR 97403-1218, USA
2Department of Pediatric Dentistry, Faculty of Dentistry, Gadjah Mada University, Yogyakarta, Indonesia

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Abstract The expression and frequency of a morphological variant of maxillary anterior teeth known as the ‘talon cusp’ is reported in a sample of 142 Malay schoolchildren from Yogyakarta, Indonesia. The trait exhibits variable and unilateral expression in the maxillary right lateral incisors of three children, yielding a frequency of 2.1%. Trait expression was graded in nature with males exhibiting larger talon cusps (Type 1, full talon; and Type 2, large semitalon) than the affected female (Type 2, small semitalon). A comprehensive analysis of the Malay primary dentition was conducted to detect possible morphometric covariation with talon cusp. Individuals with talon cusp are not significantly different from unaffected individuals in buccolingual crown size or in primary molar crown morphology. However, two of three individuals with talon cusp possess maxillary and mandibular primary canine teeth with an unusual conical crown structure. While talon cusp has previously been reported to co-occur with supernumerary teeth, including mesiodens, this is the first report of an association with cone-shaped primary canines. We address the infrequent expression of talon cusp in primary maxillary lateral incisor teeth, the presence of talon cusp in earlier and prehistoric populations, the analogous anthropological trait known as tuberculum dentale, and the treatment needs of patients with talon.

Key words: deciduous teeth, dental anomalies, tooth crown morphology

Introduction

The talon cusp is a morphological feature of incisor teeth that occurs with variable frequency in human populations, past and present (Lee et al., 2006; Sawyer et al., 1976). This ‘accessory cusp’ projects incisally from the cingulum of incisor teeth and exhibits an appearance similar to an eagle’s talon—hence the name ‘talon cusp’. Here we report the frequency and expression of talon cusp in primary teeth of a sample of 142 Malay children from Yogyakarta, Indonesia. Since morphological and numerical anomalies have occasionally been reported in association with talon cusp, we investigated the Malay dental sample for morphometric variation associated with the presence of a talon cusp.

We adhere to a comprehensive definition of the trait, one that includes all forms and expressions, and builds on an earlier definition proposed by Chin-Ying and colleagues (Chin-Ying et al., 2001). A talon cusp is a morphologically well-delineated cusp or prominent ridge that projects from the lingual, or labial, surface of maxillary or mandibular, primary or permanent anterior teeth and extends at least half the distance from the cemento-enamel junction (cingulum) to the incisal edge of the tooth. This definition does not include the commonly recorded anthropological trait known as tuberculum dentale—a tubercle of varying size and prominence originating from the lingual cingulum of maxillary incisor and canine teeth (Turner et al., 1991). Tuberculum dentale exhibits significant variation in living and prehistoric modern humans, is not uncommon in early humans (Neadertals and Homo erectus), and typically does not extend more than half the distance from the lingual cingulum to the incisal edge of maxillary anterior teeth.

This report is significant for several reasons: (1) it provides the first documentation of talon cusp in a Malay population of the Indonesian archipelago; (2) it adds to our understanding of the global distribution of a rare trait; (3) it presents the results of a systematic analysis of potential morphometric co-variation with talon cusp. While surveys of talon cusp frequency and distribution find the trait more frequent in Asian populations, primarily Chinese, talon cusp has not been reported among Malay primary or permanent teeth (Chen and Chen, 1986). Reviews of the literature report that the talon cusp is preferentially expressed in permanent maxillary central incisors (Mellor and Ripa, 1970; Mader, 1981; Hattab et al., 1996), and that the frequency of expression in permanent maxillary lateral incisors is much lower (Rusmah, 1991). Talon cusp has been reported in the primary dentition as well (Mader and Kellogg, 1985; Chen and Chen, 1986), where it occurs more frequently in maxillary central incisors than in lateral incisors. For example, in a sample of 24 individuals affected by talon cusp, the primary maxillary central incisor was affected in 22 individuals (91.6%) while the maxillary lateral incisor was observed in just one person (4.2%), and one supernumerary tooth exhibited...
ited a talon cusp (Hattab and Yassin, 1996). Finally, many reports of the talon cusp are descriptive in nature and often take the form of ‘case histories’. They do not present data regarding population frequency of the trait or include an analysis of morphometric covariation in individuals exhibiting the trait.

**Materials and Methods**

Indonesia is comprised of two main and many subsidiary ethnic groups of anthropological and clinical interest. The two main groups are the Australo-melanesian and the Malay. Ethnically, the sample under investigation consists of Malay, a name referring to the main inhabitants of Indonesia north and west of Wallace’s Line. The Malays in this study are all from south-central Java, from the city of Yogyakarta. Demographically, the study sample is comprised of 142 individuals: 61 females (42%) and 81 males (57%). It was randomly selected from a larger collection of dental impressions (n = 297) made from children attending 38 different kindergartens in Yogyakarta, Indonesia. The dental casts were made by Sri Kuswandari in 2001–2002, for a collaborative study of primary tooth crown odontometrics (Kuswandari and Nishino, 2004) and dental spacing (Kuswandari et al., 2006). Informed consent of the children’s parents was obtained prior to data collection and making impressions. This study sub-sample and the larger original collection of dental casts are similar in representation by sex (female = 137, 46.1%; male = 160, 53.9%) and mean age at examination (Table 1).

Stone plaster casts of the full maxillary and mandibular dental arcades were examined under background fluorescent and focused incandescent light. Observations included macroscopic visual assessment supplemented by examination with a hand lenses of 5× and 10× magnification. Standards set by Hattab and colleagues were used to judge the presence and classifying size of the talon cusp (Hattab et al., 1996). Measurements of tooth crown size followed procedures recommended by Kieser, using a Mitutoyo digimatic electronic caliper with direct input to a Dell laptop running Microsoft Excel (1990). Morphological observations of the primary dentition followed procedures described by Hanhara (1961) and modified by Sciulli (1998).

**Results**

Three children (2.1%) in the study sample of 142 exhibited a talon cusp (Table 2). The two affected males presented more fully developed talon cusps than the female. A detailed description of the expression of talon cusp in each affected individual follows, along with relevant biodata and documentation of associated morphometric variations. A comprehensive descriptive and comparative analysis of morphological variation in tooth crown morphology in this sample of Malay primary teeth will be published elsewhere (Lukacs and Kuswandari, n.d.).

**Table 2.** Talon cusp frequency in Malay primary teeth

<table>
<thead>
<tr>
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<th>+ (n)</th>
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<tr>
<td>Female</td>
<td>1 (61)</td>
<td>1.6</td>
</tr>
<tr>
<td>Male</td>
<td>1 (81)</td>
<td>2.5</td>
</tr>
<tr>
<td>total</td>
<td>3 (142)</td>
<td>2.1</td>
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**Case 1.**

A 6-year-old male (D-302) exhibits the fully developed form of talon cusp on the lingual surface of the maxillary right lateral incisor (Figure 1a). Upon examination the subject weighed 16 kg and had attained a height of 112.5 cm. The talon cusp projects prominently from the lingual surface, presenting a T-shaped incisal surface. The accessory talon extends from the cingulum to the incisal edge of the crown and has a maximum mesiodistal thickness of 1.7 mm. This expression of a full talon cusp is consistent with Hattab et al.’s (1996) criteria for category ‘Type 1–Talon’. The labial surface of the crown presents a minor concavity or flexure at the juncture of the incisal and labial surfaces of the dental crown but this concavity diminishes cervically. In crown size, the affected tooth (rdi) is identical to its antimere (ldi) in mesiodistal dimension (5.1 mm), yet the presence of a talon cusp increases the buccolingual dimension of the affected tooth (5.2 mm) in comparison with its antimere (4.7 mm). The central and left lateral incisor teeth present normal anatomical form in terms of morphological and metrical attributes—shovel-shape is absent from maxillary incisors. The maxillary and mandibular canines are of normal form yet exhibit robust attributes including lingual marginal ridging (shovel-shape) and the presence of a lingual median ridge extending from the cingulum to the cuspal apex (seen in the maxillary right dc–Figure 1a). The parastyle is absent from the buccal surface of maxillary first molars, and Carabelli’s trait is expressed in cuspal form on the primary right second maxillary molar and presents as a large Y-groove on the left antimerne. Accessory cusps, including the metaconule (C-5) are absent from the second maxillary molar teeth and from mandibular second molars (entoconulid–C-6); however, small expressions of the metaconulid (C-7) are present (grade 1A). Winging of mandibular central incisor teeth is marked in this individual.

**Case 2.**

This individual, a male aged 5 years and 7 months (D-209), exhibits a talon on the lingual surface of the maxillary right lateral incisor. Upon examination, the subject weighed 20 kg and was 111.0 cm high. In this subject the trait is less prominent and lacks the full cusp form of talon seen in Case 1. The median lingual talon extends from the cingulum, where it is...
most prominent, to within a few millimeters of the incisal edge (Figure 1b). Talon prominence gradually decreases from the cingulum toward the incisal edge. This expression best fits within Hattab et al.’s (1996) category ‘Type 2–Semitalon’. In crown size the right (affected) and left (unaffected) maxillary primary incisors are comparable (Table 3).

The ancillary morphological attributes of this individual include an anomalous form of the primary canine dental crown, the presence of an accessory cusp in mandibular molars, and mandibular incisor winging. An accessory cusp (entoconulid, C-6) is present bilaterally in mandibular second molars. Maxillary canines exhibit an anomalous ‘circular’ or ‘conical’ crown morphology. The characteristic buccolingual (BL) compression and mesiodistal (MD) elongation of the crown is absent. In occlusal view, the crown shape is circular and the greatest crown dimensions are at the base of the crown, at the gingiva. In labial (facial) view, the crown outline is ‘conic’ rather than the more characteristic ‘diamond’ shape of primary incisors (Figure 2). Typically the greatest mesiodistal diameter of the maxillary canine crown is at mid-crown height or approximately mid way between the cervix and the apex of the crown. These features are not discernible in the maxillary or mandibular canines of this subject. Expression of C-6 size is asymmetric, and is noticeably larger (grade 3) in the left than the right (grade 1) second molar. Slight expression of bilateral winging was observed in the mandibular central incisors. Other systematically recorded morphological attributes are absent (in maxillary teeth: shovel-shaped incisors, first molar para-style, Carabelli’s trait, metaconule; in mandibular teeth: metaconulid).

| Table 3. Crown dimensions maxillary lateral incisors (D-209; in mm) |
|--------------------------|--------------------------|
|                          | mesiodistal  | buccolingual |
| rdi² (with talon)        | 5.6          | 4.4          |
| ldi² (lacking talon)     | 5.7          | 4.5          |

Figure 1. Graded expression of talon cusp in Malay primary teeth. (a) D-302: male, 6.0 years old—full-talon (grade 1); (b) D-209: male, 5.58 years old—semitalon (grade 2); (c) D-308: female, 3.25 years old—trace-talon (grade 3). Classification of talon expression follows Hattab et al. (1996, p. 375).

Figure 2. Connate canine teeth (left) of subject D-308 are present bilaterally and associated with Type 2 talon cusp.
Case 3.
The mildest expression of talon cusp in this sample was observed in a female aged 3 years and 3 months (D-308). At examination the subject weighed 20.0 kg and was 109.5 cm in height. This individual exhibits a median lingual ridge on the primary right lateral incisor. The ridge extends from the well-developed lingual cingulum, is broadest mesiodistally at mid-crown, and then narrows and fades into the lingual fossa a few millimeters from the incisal edge. Classifying this form of talon is difficult for several reasons: (1) the ridge exhibits wear at mid-crown, a factor that has reduced, by an unknown amount, the extent to which the ridge projected lingually; (2) the talon extends more than half the distance from the cingulum to the incisal edge, which is one criterion for assignment to the ‘Type 1–Talon’ category; (3) the talon blends with the lingual surface of the crown and its ridge-like form does not project more than a few millimeters lingually, consistent with the description of the ‘Type 2–Semitalon’ category. In our judgement this expression is best classified as a Type 2 talon cusp, though it is not as prominently expressed as the stronger form of semitalon seen in Case 2 (above, Figure 1b).

In tooth crown morphology, subject D-308 lacks shoveling of maxillary central incisors, but exhibits a weak cusp-5 or metaconule (grade 1) and Y-form of Carabelli’s trait bilaterally on primary maxillary second molars. The mandibular second molars lack prominent accessory cusps, though the right second molar possesses a weak expression of the metaconule (C-7). The mandibular central incisors are aligned straight and lack unilateral or bilateral winging.

The etiology of talon cusp is poorly understood. Initiation may involve cellular hyperplasia and folding of the inner enamel epithelium during the morphodifferentiation stage of tooth development (Hattab et al., 1996). The higher frequency of talon cusp in males could result from the influence that the Y chromosome has on dentinogenesis, and amelogenesis a factor contributing to sexual dimorphism in tooth size (Alvesalo, 1997). We therefore tested for differences in mean tooth size (buccolingual dimension) between males with and without talon cusp. The results are presented in Table 4 and reveal that mean crown diameters in individuals possessing talon cusps are not significantly different in size from those lacking this structure. The small number of individuals possessing the trait and the difference in size of the samples being compared reduce the power of this analysis.

Nevertheless, the close similarity between affected and unaffected individuals suggests that no association exists between talon cusp presence and overall tooth size.

In sum, while all three individuals with talon cusp also possess accessory cuspules in maxillary and/or mandibular molars, accessory cusps are present in low to moderate frequencies in the sample under study (in individuals lacking talon cusp). By contrast, the presence of the unusual ‘cone-shaped’ primary canine constitutes a new morphological feature that is unique in this sample and co-occurs exclusively with individuals possessing a talon cusp. Overall tooth size does not appear to be influenced by the presence or absence of a talon cusp.

| Table 4. Mean crown size of individuals with and without a talon cusp (males, buccolingual, mm) |
|-----|-----|-----|-----|-----|
| maxilla | lacking talon cusp | with talon cusp |
| | n | mean | sd | P | n | mean | sd |
| i′ | 68 | 4.9 | 0.33 | 0.285 | 2 | 5.2 | 0.21 |
| i′ | 69 | 4.7 | 0.35 | 0.771 | 2 | 4.8 | 0.23 |
| c | 71 | 5.9 | 0.59 | 0.428 | 2 | 6.3 | 0.02 |
| m1 | 76 | 8.5 | 0.50 | 0.867 | 2 | 8.4 | 0.23 |
| m2 | 75 | 9.8 | 0.44 | 0.927 | 2 | 9.8 | 0.57 |

Discussion

A few important points are addressed in this section: (a) the significance of findings reported here; (b) anthropological issues relating to (i) prehistoric expressions of the trait, and (ii) the need to carefully distinguish between talon cusp and tuberculum dentale, and (c) the potential liability that full expression of talon cusp poses for those who have this feature and the need to carefully evaluate whether treatment is necessary.

The relative rarity of talon cusps in primary maxillary lateral incisor teeth enhance the significance of the findings reported here. In 73 cases of talon cusp, Hattab and colleagues found that 75% or 55 cases involved permanent teeth, while only 25% or 18 cases were in primary teeth (Hattab et al., 1996). Reporting on the presence of talon cusp in the primary teeth of a Chinese sample, Chen and Chen (1986) assert that their review of the literature revealed only four cases of talon cusp in primary incisor teeth. Subsequently, Subba Reddy and Mehta (1989) combined evidence from two sources (Chen and Chen, 1986; Davis and Brook, 1986) to document more frequent occurrence of talon cusp in permanent (80.8%; 42/52) than in primary teeth (19.2%; 10/52). In a group of 24 individuals with talon cusp, primary maxillary central incisors were observed in 22 individuals (91.6%), while in only one instance (4.2%) was a maxillary lateral incisor affected, and one supernumerary tooth (4.2%) exhibited a talon cusp (Hattab and Yassin, 1996). In a more recent survey of the literature reporting expression of talon cusp in primary teeth, Mays (2005) found that 37 individuals possessed 50 teeth with a talon cusp. An especially remarkable finding in this study is the uneven distribution of the trait among primary tooth types: 86.6% of affected teeth were maxillary central incisors (n = 43), while only 8.8% were maxillary lateral incisors. The remaining three cases (6.0%) included an unspecified maxillary incisor, a supernumerary dental element, and a mandibular lateral incisor tooth (Mays, 2005). The consensus of current research on expression of talon cusp in primary teeth is that the maxillary central incisor is significantly more frequently affected than the maxillary lateral incisor. Consequently, the presence of a talon cusp unilaterally in three maxillary lateral incisors in three
individuals in a sample of 142 Malay children adds significantly to knowledge of the ethnic distribution of this enigmatic trait, as well as to the frequency and graded nature of its expression.

Reports of talon cusp in the dental anthropology literature are rare and appear in nonclinical or unindexed publications (Sawyer et al., 1976; McNamara, 1997; Turner, 1998). For example, while several papers cite Henderson (1977) as the first to report the presence of talon cusp in primary teeth (Mader and Kellogg, 1985; Subba Reddy and Mehta, 1989; Hattab et al., 1996; Chin-Ying et al., 2001), the earlier description, in 1976, of talon cusp in a prehistoric, pre-Columbian specimen from Peru takes precedence (Sawyer et al., 1976). This case, a worn maxillary central primary incisor, is from a mummified child of the Paracas culture who died between 5 and 6 years of age, and constitutes the earliest documented case of talon cusp—dating to approximately 2000 years BP (or 250 BC).

Labial talon cusps have also been reported in the maxillary permanent incisor teeth of prehistoric Native North Americans. One from the Petrified Forest District of northeastern Arizona (Turner, 1998) and five cases in a sample of 301 specimens (1.7%) of Late Woodland Native Americans from Illinois (Mayes, 2007). While the preponderance of clinical and prehistoric evidence for talon cusp comes from Asian and Asia-derived Native Americans, the presence of a medieval case from England, dating to between 930 and 1350 AD, requires vigilance among bioarchaeologists in the analysis of dental remains from any continent (Mays, 2005).

We agree with Mays (2005) that the broad range of frequencies reported for talon cusp in primary maxillary teeth results in part from some investigators’ inclusive definitions of the trait (Chawla et al., 1983). Care must be exercised in differentially diagnosing talon cusp from tuberculum dentale—a morphological feature that may easily be mistaken for trace expressions of talon cusp. We recommend that when planning research protocols, investigators consult graphical standards for recognition and scoring variation in tuberculum dentale (Turner et al., 1991; Scott and Turner, 1997). Excellent graphic images of tuberculum dentale can be found in classic odontological monographs on the east Greenland Eskimo (Pedersen, 1949), and Homo erectus (Weidenreich, 1937), as well as in studies of the crown morphology of modern living and prehistoric human populations (Lukacs, 1987, Figure 2, p. 101). Further comparative investigation of nomenclature and variation of these traits may reveal that the trace category of talon cusp is synonymous with the anthropological feature tuberculum dentale.

Finally, consideration is given to the potential liability that full expression of talon cusp poses for those who possess it and the need to carefully evaluate patient status and plan treatment. Among the treatment considerations for individuals with talon cusp, Mader and Kellogg (1985) list six potential issues, including: (1) unaesthetic appearance, (2) malocclusion, (3) excessive attrition resulting in pulp exposure, (4) predisposition to caries, (5) irritation of soft tissue, and (6) mistaken recognition radiographically resulting in unnecessary surgical procedure. A recent study of the relationship between talon cusp in primary maxillary incisors and numeric or morphologic anomalies in permanent successors adds a new dimension to treatment concerns. Analysis of 35 Chinese children possessing primary maxillary central incisor teeth with talon cusp revealed a high frequency (91.4%, n = 32) of odontogenetic anomalies in the succeeding permanent dentition (Lee et al., 2007). By contrast, when talon cusp was present in primary maxillary lateral incisor teeth (n = 23 cases), permanent successors exhibited morphogenetic anomalies less frequently (78.3%, n = 18) (Lee et al., 2007). Permanent successors to primary maxillary incisors with talon cusp display a range of morphogenetic anomalies, including supernumerary elements, variant morphology, such as barrel, peg and conical dental crowns, as well as tuberculated, missing, and malpositioned teeth. Consequently when ‘Semitalon’ (Type 2) and ‘Talon’ (Type 1) forms of talon cusp are observed in the primary teeth of young children, greater care must be exercised in monitoring dental health and development. While all children should be screened for talon cusp upon dental examination, greater vigilance is recommended when clinics or dental practices serve populations in which the trait appears to occur more frequently, such as Asian and Pacific Island populations (Jerome and Hanlon, 2007). Dental examinations could be scheduled more frequently for children with talon cusp and special attention devoted to possible anomalies in the permanent successors to affected teeth.

Conclusions

A morphological variant of maxillary anterior teeth known as the ‘talon cusp’ occurs with a frequency of 2.1% in a sample of 142 Malay schoolchildren form Yogyakarta, Indonesia. The trait exhibits variable and unilateral expression in the maxillary right lateral incisors of three children. Trait expression was graded in nature and males exhibited larger talon cusps (Type 1, ful talon; Type 2, large semitalon) than the affected female (Type 2, small semitalon). A comprehensive analysis of the Malay primary dentition found that individuals with talon cusp are not significantly different from unaffected individuals in buccolingual crown size. In terms of tooth crown morphology individuals with talon cusp display accessory molar cusps with a size and form similar to children lacking talon cusps. However, two of three individuals with talon cusp possess maxillary and mandibular primary canine teeth with an unusual conical crown structure. While talon cusp has previously been reported to co-occur with supernumerary teeth, including mesiodens, this is the first report of an association with conical primary canines. Issues concerning: (a) the infrequent expression of talon cusp in primary maxillary lateral incisor teeth, (b) its presence in earlier and prehistoric populations, (c) the analogous anthropological trait known as tuberculum dentale, and (d) the treatment needs of patients with talon cusp are also discussed.

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References