

Prevalence of accessory tooth cusps in a contemporary and ancestral Hungarian population

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SUMMARY Dental morphological characteristics are useful for providing information for phylogenetic and genetic studies and understanding variations within and among species. Carabelli and talon cusps are expressed in several degrees and different frequencies between humans, thus being useful in comparing and characterizing populations. The purpose of this study was to examine the incidence and degree of expression of a Carabelli tubercle and talon cusps in a contemporary Hungarian population compared with similar findings in the dentition of skulls dating from the 11th century, the so-called Árpád-era.

The data were collected by examination of dental plaster casts of 600 children aged 7–18 years (304 males, 296 females) undergoing orthodontic treatment. The dentitions of 147 skulls, dating from the 11th century, from the ancient Halimba-Cseres cemetery stored at the Hungarian Natural History Museum were also examined. The incidence and degree of expression of a Carabelli cusp was investigated for the upper first permanent molars and scored according to an eight-grade classification system. The talon cusps on the upper permanent lateral incisors were also examined. A chi-square test was used for statistical analysis.

The prevalence of Carabelli cusps was 65.34 per cent in the contemporary and 34 per cent in the 11th century population ($P < 0.01$). The contemporary group showed a prevalence of talon cusps of 2.5 per cent compared with 40.8 per cent for the skulls from the Árpád-era, which was significant ($P < 0.001$).

These findings demonstrate that the contemporary Hungarian population is a mixture of European and Mongoloid races. The data are in agreement with linguistic evidence that shows that distant Hungarian ancestors belonged to the Finno-Ugrian family of people, whose habitats extended from the Baltic to the middle Urals.

Introduction

A Carabelli cusp is a characteristic morphological anomaly located on the mesial palatal surface of the upper first permanent molars. It is rarely present on the second or third permanent molars, or on the upper first primary molars. It has most commonly been detected symmetrically on both sides of the upper jaw (Alvesalo *et al.*, 1975).

The aetiology of a Carabelli cusp remains unknown. Both genetic and exogenous factors have been proposed. Most studies agree that the phenotypical appearance of the cusp is genetically determined. According to Dietz (1994), there must be a dominant gene responsible for the presence of the cusp.

The cusp was first described in 1842 by Carabelli (Mitchell, 1892). Since that time many studies have been conducted concerning the morphology of the cusp, its anthropological importance, and the mode of heredity. The incidence and degree of expression differ among species; therefore, it can be used to detect and to compare different populations (Palomino *et al.*, 1977). According to Bermúdez De Castro (1989), Carabelli's trait can be useful in establishing phylogenetic relationships between closely related populations. The cusp may rival the main cusps in size, whereas other related forms include a small ridge, pit,

or furrow. A similar structure, the cingulum, is found among apes and gibbons (Dahlberg, 1963; Hilson, 2002).

A Carabelli cusp has been found in *Australopithecus*, Neanderthal man, when it was only a groove. Therefore, it has been suggested that there has been an evolution in Carabelli's cusp from a simple groove to a well-developed cusp (Dahlberg, 1963).

A talon cusp, which was also investigated, is an uncommon dental anomaly referring to an accessory cusp-like structure projecting from the cingulum area or cemento-enamel junction of the maxillary or mandibular anterior teeth in both the primary and permanent dentitions (Hattab *et al.*, 1996).

The aetiology of a talon cusp is also unknown; genetic and exogenous factors may combine together to cause the cusp to develop. Similar to other defects in tooth form, a talon cusp originates during the morphodifferentiation stage of tooth development (Hattab *et al.*, 1996). It has been suggested that this anomaly is primarily polygenetic with some environmental influence. The prevalence is higher in oriental races and can be present with other syndromes, i.e. pin-shaped teeth, retained canines, and odontomes (Davis and Rook, 1985; Hattab *et al.*, 1996; Henderson, 1997; McNamara *et al.*, 1998; Hedge and Kumar, 1999).

Mitchell (1892) first described the cusp, and Mellor and Ripa (1970) named the accessory cusp as 'talon/claw/cusp' because of its resemblance in shape to an eagle's talon. It can produce either a T or V form, or if lower in level, a Y-shaped crown contour (Gorlin and Goldman, 1970). Sometimes it also appears on the central incisors.

The aim of the present study was to detect the incidence and degree of expression of both Carabelli and talon cusps in a contemporary Hungarian population and to evaluate their appearance from an anthropological point of view by comparison with the prevalence of the two cusp types on teeth from 11th century skulls.

Materials and method

The models of 600 children aged 7–18 years (304 males, 296 females) from the Orthodontic Department at Semmelweis University, Budapest, and a total of 147 skulls from the Department of Anthropology of the Hungarian Natural History Museum dating from the 11th century, in a well preserved condition with all maxillary teeth present, were examined to determine the incidence of Carabelli and talon cusps. The skulls were found in the Halimba-Cseres cemetery which consisted of 932 graves from the so-called Árpád-era (Török, 1998).

Dahlberg's (1963) scale was used to examine the Carabelli cusps. There are seven types of cusps in this classification (Table 1) divided by size (Boros, 1961; Dahlberg, 1963). The system used to examine the talon cusps (Table 2) was developed by Hattab *et al.* (1996). The cusps are divided into three types according to shape and size.

Table 1 Dahlberg's (1963) scale for the determination of degree and expression of Carabelli cusps.

0	No vertical ridges, pits, or other manifestations on the mesiolingual cusp
1	Small vertical ridge and groove
2	Small pit with minor grooves diverging from a depression
3	Double vertical ridges or slight and incomplete cusp outline
4	Y form: moderate grooves curving in opposite directions
5	Small tubercle
6	Broad cusp outline or moderate tubercle
7	Large tubercle with free apex in contact with lingual groove (height often approximates that of major cusps)

Table 2 Classification of talon cusp using the scale of Hattab *et al.* (1996).

Type 1	A defined cusp on the palatal surface of the incisors both in the permanent and primary dentition; it covers at least half of the distance between the incisal edge and the cementoamel junction (CEJ)
Type 2	The cusp covers less than half of the distance between the incisal edge and the CEJ but it is larger than 1 mm
Type 3	A small tubercle located on the gingival third of the tooth. It can be T, Y, or V shaped

Prior to the main investigation, for calibration purposes, two authors (KM and MB) separately examined 30 models with a magnifying glass (Carl Zeiss D36, Jena, Germany) at $\times 9$ magnification under direct light. There was no difference in the findings. A chi-square test was used for statistical analysis.

Results

Of the 147 examined skulls, 51 presented Carabelli cusps on the upper first permanent molars, a prevalence of 34 per cent. The difference between the contemporary group and the skulls of the Árpád-era was significant ($P < 0.01$).

According to the Dahlberg scale, in the contemporary group the prevalence of the smallest cusps was 11.3 per cent and of the largest cusp 3.6 per cent. The prevalence of the smallest and largest cusp in the 11th century skulls was 11.7 per cent (Table 3).

Talon cusps were found in 15 subjects (2.5 per cent) in the present-day population and in 60 skulls, a prevalence of 40.8 per cent. The difference in the number of talon cusps between the contemporary group and the 11th century skulls was significant ($P < 0.001$).

Twelve talon cusps in the contemporary group were type 1, two were type 2, and one type 3, all located on the upper lateral incisors. In two cases, the cusps were T shaped and the rest V shaped. For the 60 skulls, 31 were type 1, 21 type 2, and eight type 3 (Table 4). All were V shaped and located on the upper lateral incisors.

Discussion

The study of dental morphological characteristics and odontometry is important in anthropological research since it can provide information on the phylogenetic relationship between species, as well as variations and diversities within a population (Sharma, 1983; Palomino *et al.*, 1997).

It is commonly accepted that dental characteristics, such as size, shape, presence, number of cusps, and also the size of the dental arches, are genetically determined (Gouse and Lee, 1971). For this reason, the above-mentioned characteristics differ among races and species and can constantly alter due to natural selection and genetic changes.

The most commonly detected dental characteristic is the Carabelli cusp. This can be used to determine the degree of intercourse between populations with different racial characteristics (Gouse and Lee, 1971). Dahlberg's (1963) classification is the most commonly applied method for determining the degree and expression of Carabelli cusps (Kieser and Van Der Merwe, 1984).

Dental characteristics can be divided into the so-called 'western' (including Carabelli cusps) and eastern (Kraus, 1951; Alvesalo *et al.*, 1975) types. The frequency of a Carabelli cusp is high in Europeans, 70–90 per cent, but low

Table 3 Degree and expression of a Carabelli cusp in the contemporary patient group and 11th century skulls according to the scale of Dahlberg (1963).

Dahlberg's scale	0	1	2	3	4	5	6	7
Contemporary group	207	68	26	102	45	99	31	22
Percentage	34.6	11.3	4.3	16.8	7.6	16.5	5.3	3.6
Skull group	6	9	12	5	5	3	5	6
Percentage	11.7	17.6	23.5	9.8	9.8	5.88	9.8	11.7

Table 4 The prevalence and type of talon cusps in the contemporary ($n = 600$) and 11th century skulls ($n = 60$) according to the scale of Hattab *et al.* (1996).

Types of talon cusp	Type 1	Type 2	Type 3
Contemporary group	12	2	1
Percentage prevalence	2.0	0.33	0.16
Skull group	31	21	8
Percentage prevalence	50.00	35.00	13.33

in oriental races (Alvesalo *et al.*, 1975). The findings of the present study showed a prevalence of 65.34 per cent in the contemporary group, and 34 per cent for the 11th century skulls, which is, in both cases, lower than the European average. In Malaysian children, the frequency of a Carabelli cusp on the maxillary first molars was 54.2 per cent (Rushman and Meon, 1991). In India, 52.77 per cent of maxillary first permanent molars displayed a Carabelli tubercle (Kanappan and Swaminathan, 2001). Hassanali (1982) showed that Carabelli's trait was present in 26–27 per cent of Asian school children. Caucasoid populations differ from Mongoloids by having a high prevalence of Carabelli's trait (Hsu *et al.*, 1997). As shown in different studies, the intercourse between European and Mongoloid population leads to a reduction of total frequency of prevalence in the Europid population (Kraus, 1951; Palomino *et al.*, 1977; Scott, 1980; Gianniou *et al.*, 2000).

The prevalence of talon cusps in the contemporary material was 2.5 per cent, compared with the high prevalence found for the skulls from the Árpád-era (40.8 per cent). Chawla *et al.* (1983) found a prevalence of 7.7 per cent in children from North India. The incidence of a talon cusp in the Chinese population is much higher than previously considered (Chen and Chen, 1986) and a prevalence of 52.2 per cent has been reported in Malaysia (Rushman and Meon, 1991).

These morphological anomalies have great significance, both orally and anthropologically. The anatomy of the teeth can provide information on a population and as they are not often influenced by time, they can be studied on skeletons, and the development and changes of a population can be followed. The morphology and prevalence of Carabelli cusps can provide answers to many questions, such as division of a population into western or oriental type dentition, the mixture of races within a population, and the

homogeneity of European and oriental populations. A Carabelli cusp is more common in Europeans than Mongoloids, while a talon cusp is less common in Caucasians than Mongoloids (Buenviaje and Rapp, 1984).

Conclusion

The present Hungarian population is a mixture of eastern and western races. The data are in agreement with the linguistic evidence (Szentpéteri, 1996) that shows Hungarian ancestors belonged to the Finno-Ugrian family of people whose habitats extended from the Baltic to the middle Urals, and, from where, on the east–west migration route, they came to settle in the Carpathian Basin in 896 AD, mixing with people living there during the previous millennium (Macartney, 1962; Török, 1962).

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