



Relationship of Carabelli's Trait Between the Upper Second Deciduous and First Permanent Molars

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Abstract

Background: Carabelli's trait is an inner knob near the second molar and the first permanent molar and has been used as an important ethnic index for decades. It can be used to show great ethnic differences in dentistry.

Objectives: The aim of this longitudinal study was to determine: (1) the frequencies of Carabelli trait and (2) the relationship of Carabelli's trait between the deciduous and permanent teeth.

Method: The sample consisted of 64 pairs of dental casts (32 boys, 32 girls, aged 3–5 and 12–14) on Vietnamese people.

Results: The frequencies of pits and grooves were high (deciduous teeth: 51.56%, permanent teeth: 39.06%). By contrast, the frequencies of pronounced tubercular forms were low (25% in both dentitions). The correlation coefficient between the deciduous and permanent teeth was 0.65 ($p < 0.01$).

Conclusions: The frequencies of the pit and groove forms of Carabelli's trait were high in both dentitions. A highly significant positive correlation was noted for Carabelli's trait between dentitions.

ARTICLE HISTORY

Received December 28, 2019 Accepted January 20, 2020 Published June 17, 2020

KEYWORDS

Carabelli's trait, relationship, deciduous and permanent teeth, Vietnam.

Introduction

Dental anatomical characteristics are important evidence that can be used directly to identify a person's identity, origin, and gender. These characteristics also reflect the nature and extent of diversity among human populations [1]. Teeth have long been recognized as extremely valuable fossil materials for scientists who study human history [2]. Dental anatomy is also capable of providing comprehensive descriptions of human dentistry [3].

One of the first and most important characteristics recorded was Carabelli's trait, described in 1842 by Sir Georg Carabelli [4]. Carabelli's trait is the inner knob near the second molar and the first permanent molar

[5]. Dahlberg's (1963) classification is the most commonly applied method for determining the degree and expression of Carabelli cusps [6]. The cusp may rival the main cusps in size, whereas other related forms include a small ridge, pit, or furrow. Many studies show that this characteristic has many variations and appears on the upper second deciduous and first permanent molars [7, 8]. However, very few studies have been performed on the same individual. Therefore, the aim of the present study was to examine the potential correlation of Carabelli's trait in the upper second deciduous and first permanent molars of the same individual to determine the ratio of Carabelli's

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trait expression levels in m2 and M1 and to evaluate their correlation.

Table 1. The percentages of Carabelli's trait in m2 and M1 in the upper jaw

| Group | | n (%) | | | χ^2 (df=2) | p |
|-------|---------------|-----------------------------|--------------------|-------------|-----------------|-------|
| | | No expression Carabelli (%) | Groove and pit (%) | Cusp (%) | | |
| m2 | Male (n=32) | 8 (25.00%) | 20 (62.50%) | 4 (12.50%) | 5.55 | >0.05 |
| | Female (n=32) | 7 (21.88%) | 13 (40.62%) | 12 (37.50%) | | |
| M1 | Male (n=32) | 12 (37.50%) | 13 (40.62%) | 7 (21.88%) | 0.33 | >0.05 |
| | Female (n=32) | 11 (34.38%) | 12 (37.50%) | 9 (28.12%) | | |
| m2 | Total (n=64) | 15 (23.44%) | 33 (51.56%) | 16 (25.00%) | 2.97 | >0.05 |
| M1 | Total (n=64) | 23 (35.94%) | 25 (39.06%) | 16 (25.00%) | | |

The proportion of Carabelli's trait in m2 and M1 from different ethnicities was higher in our Vietnamese group than in Japanese, African American, and Australian native groups but lower than a Caucasian group (Table 2) (Hanihara, 1976).

Table 2. Ratios of Carabelli's cusp (%) in the m2 and M1 maxillary groups

| Characteristic | Carabelli cusp n (%) | |
|-------------------|----------------------|------------|
| | m2 | M1 |
| Australian* | 21.0 (105) | 15.7 (159) |
| Japanese* | 11.9 (185) | 6.5 (444) |
| Caucasian* | 35.7 (56) | 39.0 (59) |
| African American* | 11.8 (51) | 16.3 (80) |
| Vietnamese** | 25.0 (64) | 25.0 (64) |

*Hanihara (1976); **Khang (2011).

Table 3 shows that Carabelli's trait has a significant correlation between the deciduous and permanent teeth ($r = 0.65$; $p < 0.01$). This result is similar to the findings of Edgar and Lease (2007) for European Americans. Salako and Bello (1998) showed that Carabelli's trait between m2 and M1 maxillary teeth in a Saudi Arabian community differed in the frequency of expression of the degree of knob shape between these two teeth. A study by Scott et al. (1983) on a population of Pima Indians showed that Carabelli's trait on teeth could appear as a groove or small knob, and rarely as a large knob, but the author did not give specific correlation coefficients [14, 15]. Smith et al. (1987) conducted a study on samples of jaws from children aged 7-11 years from 4 different ethnic groups and found less Carabelli's trait expression in m2 than in M1 [17].

Table 3. The correlation coefficient r for Carabelli's trait between m2 and M1 in different ethnic groups

| Studies | Carabelli (n) m2 - M1 | | |
|--------------------------------------------|-----------------------|-------------|-------------|
| | Male | Female | Total |
| H.K. Khang, 2010 (Vietnamese) (15) | 0.63** (32) | 0.64** (32) | 0.65** (64) |
| Edgar, 2007 (European American group) (16) | | | 0.68** (53) |

** $p < 0.01$

Methods

Study design and subjects

Descriptive longitudinal studies and morphological analyses to determine the correlation of Carabelli's trait between m2 and M1 were performed on cast jaw samples taken from the collection of jaw samples at the Faculty of Odonto-Stomatology, University of Medicine and Pharmacy at Ho Chi Minh City. This is a collection of a vertical monitoring program for the development of Vietnamese craniofacial and dental development in persons between 3 and 18 years of age. The collection was conducted in November 1996 by Prof. Dr. Hoang Tu Hung, who presides at the Faculty of Odonto-Stomatology - University of Medicine and Pharmacy at Ho Chi Minh City [7].

Sample size

The sample consisted of 64 pairs of dental casts taken at ages 3-5 years and ages 12-14 years of the same child who met the selection and exclusion criteria, for a total of 128 functional samples. Inclusion criteria were pairs of dental casts prepared when the teeth were fully formed, teeth without abnormal crown shape, casts showing the top of the zone and the central fossa, and teeth without much wear on the chewing surface. Exclusion criteria were pairs of dental casts with errors due to breakage or foaming.

Study instrument

The study used a visual observation method combined with the use of a magnifying glass to evaluate and

classify the characteristics of Carabelli's trait on jaw samples according to Hanihara (1963) [9]. Carabelli's trait was observed and evaluated four times on both sides of the jaw (right and left) using a scoring method on an individual basis [10]. If an asymmetry was noted on either side, the side with the highest score was used as the score for each tooth type for statistical analysis.

The scoring method was based on the Carabelli cusp as the auxiliary knob emerging on the inner side near the maxillary teeth, as shown in **Figure 1**.



- 0: No Carabelli's trait expression;
- 1: small vertical ridge and groove on the inside surface;
- 2: Small pit;
- 3: Double vertical ridges;
- 4: Small cusp;
- 5: Medium cusp;
- 6: Large cusp;
- 7: Very large tubercle with a free apex in contact with lingual groove (height often approximates that of the major cusps)

Figure 1. Carabelli's trait on m2 of the upper jaw

The degree of Carabelli's trait on m2 and M1 of the upper jaw was investigated using subgroups for ease of comparison with the findings from other studies. The samples were divided into 3 groups: "No expression Carabelli" 0; "Groove and pit" 1, 2, and 3; and "Cusp" 4, 5, 6, and 7.

Data analysis

The research applied the method of descriptive statistics and calculation of points and percentages of characteristics. Spearman correlation analysis (r) was used to assess the correlation of Carabelli's trait between m2 and M1. Carabelli's trait was also evaluated and classified twice, separated by two weeks. The kappa index was used to assess observer stability (For m2 and M1, the kappa index values were 0.84 and 0.88, respectively).

Ethical considerations

The research protocol was reviewed by the ethics committee of the University of Medicine and Pharmacy at Ho Chi Minh City before the study was conducted.

Results and Discussion

Both sets of teeth showed that Carabelli's trait has the highest rate of pits and grooves (respectively 51.56% in m2 and 39.06% in M1). In both sets of teeth, the ratio of large Carabelli's knobs was low, at 25.00% (**Table 1**, **Figure 2** and **Figure 3**). The levels of Carabelli's trait differed between m2 and M1 but the differences were not statistically significant ($p > 0.05$).

CONCLUSION

The study findings showed that Carabelli's trait was expressed in dental casts from both deciduous and permanent teeth. Overall, Carabelli's trait appeared at the highest frequency as pits and grooves. No difference was noted in the levels of Carabelli's trait expression between m2 and M1. A significant positive correlation was observed for the presence of Carabelli's trait in both m2 and M1 in the same person ($r = 0.65$; $p < 0.01$).

Acknowledgments

The authors are grateful to the Faculty of Odonto-Stomatology, University of Medicine and Pharmacy at Ho Chi Minh City for their kind help.

Conflict of interest

The authors declared that they have no conflict of interest.

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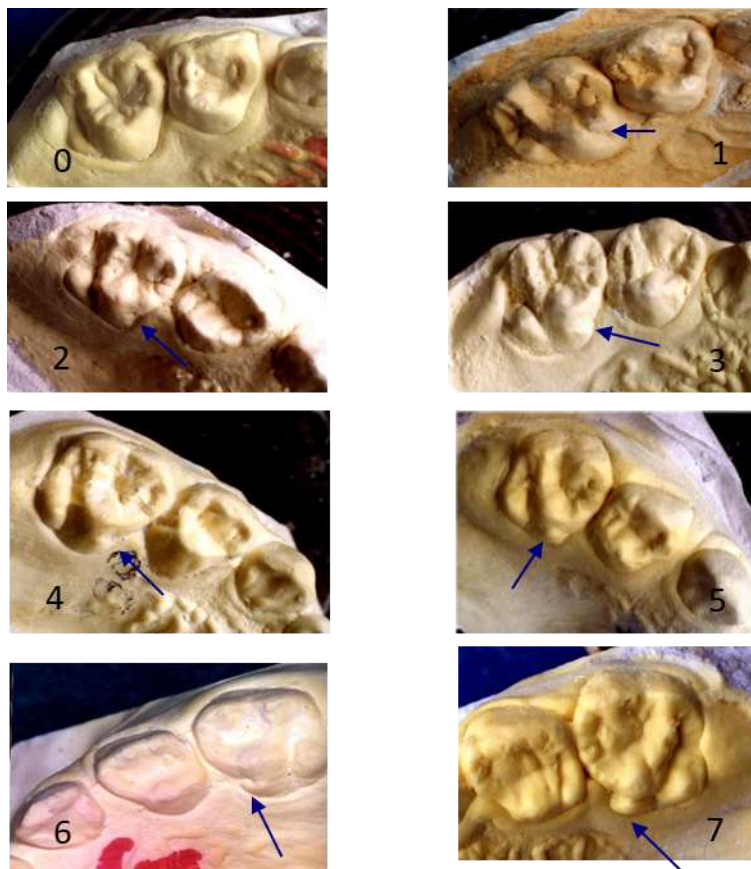


Figure 2. Degrees of Carabelli's trait in m2 of the upper jaw

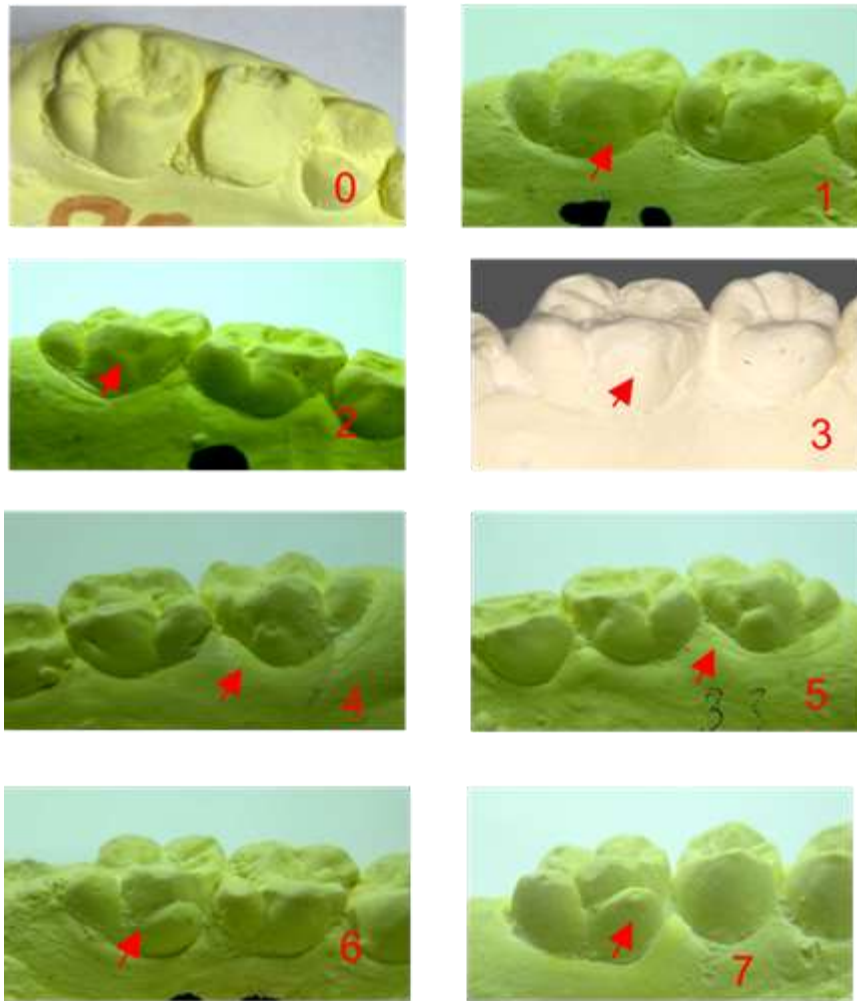


Figure 3. Degree of Carabelli's trait in M1 of the upper jaw

The correlation of Carabelli's trait between the upper second deciduous and first permanent molars