



The Prevalence of the Carabelli Trait in Selected Nepalese Population

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Authors' contributions

This work was carried out in collaboration between all authors. Author NS designed the study, wrote the protocol, and prepared the first draft of the manuscript. Author TPC managed the data entry and searched the literature. Author SS helped in collection of data and prepare the second draft manuscript. Author SP performed statistical analysis and helped in designing the study. Author AP helped in collection of data and arranging references. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The purpose of this study is to determine the prevalence and degree of expression of the carabelli trait in the permanent first and second maxillary molars in a selected Nepalese population residing in Madi village of Chitwan district.

Study Design: Cross sectional descriptive study.

Place and Duration of Study: Madi village of Chitwan district in the month of April 2014.

Methodology: The study was conducted among the 300 dental patients of age 14 years and above attending a dental health camp. The palatal surfaces of the mesio-lingual cusp of the left and right maxillary first and second molars of the subjects were examined with mirror and probe for the presence or absence of the Carabelli trait. When present, the Carabelli trait was graded as I-IV, pit (I), groove (II), cusp without free tip (III), and well developed cusp (IV) according to the classification of Goose and Lee.

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Results: The mean age of the patients was 39.47 +/-16.33 years with male: female ratio of 1:1.01. Two hundred five (68.3%) of the cases had presence of carabelli trait on either of the first molars. Further, 75 (25.0%) had carabelli trait on either of the second molars. None of the cases had the trait only in second molars. The association of carabelli trait had no significant relation to sex (P=0.15). Bilateral presence of the carabelli trait in 16 and 26 was noticed in 151 (73.7%) of the total 205 cases. Likewise, the bilateral expression in 17/27 was seen in 53 (70.7%) of the total 75 cases. The association of the trait bilaterally was significant for both the sides (P<0.001).

Conclusion: The expression of carabelli trait in the selected Nepalese population is fairly high although frank cusp was rarely noticed. The bilateral presence of the trait was common. The study of the presence and degree of expression of the trait is implied in the determination of ethnic origin of the individuals.

Keywords: Anthropology; carabelli trait; forensic dentistry; identification.

1. INTRODUCTION

Dental techniques are frequently used in human identification; some of those include comparative analyses of dental features like restorations, alignment of teeth etc that, being rare or unique to an individual, can establish a positive identification. The usefulness of each feature depends on its population, frequency, and uniqueness. On the other hand, dental anatomic features are used mainly to establish a person's origin and sex. The importance of a dental anatomical trait depends on its frequency in a given population [1].

The Carabelli structure is a tubercle or cuspule, or a groove, often seen on the palatal surface of the mesiopalatal cusp of maxillary permanent molars and maxillary second deciduous molars [2] and is the most commonly occurring dental morphological characteristic that is useful in forensic, anthropological and ethnic studies [3]. The expression of carabelli trait is a result of interaction between genetic and environmental factors [4]. If one were to put forward the single most significant aspect of CT it would be its ethnic variation.

Carabelli trait has always been a fascinating morphological trait for dentists, geneticists and anthropologists. As enamel is the hardest tissue in the body, teeth preserve longer than any other human remains. As such, teeth are equally accessible to the investigator in fossils and in the living and in the laboratory as well as in the field. Therefore continuity between living and ancestral or skeletal populations can be established more easily with dentition. Observation of teeth in the oral cavity is also noninvasive and inexpensive.

Nepalese society is ethnically diverse and complex in phenotype (physical characteristics)

and culture ranging between Indian to Tibetan population [5]. Chitwan is regarded as seventy sixth district as it is resided by people from throughout the 75 districts of the nation. So, we can find people of different ethnic groups. Studies demonstrating the prevalence of carabelli trait in Nepalese population have not been reported so far. The purpose of this study is to determine the prevalence and degree of expression of the carabelli trait in the permanent first and second maxillary molars in a selected Nepalese population residing in Madi village of Chitwan district. This study can be a milestone to reflect the trend of expression of the trait which can be implied in dental identification process.

2. MATERIALS AND METHODS

The study was conducted among the dental patients of age 14 years and above attending a dental health camp in Madi VDC of Chitwan district. All patients were informed about the purpose of the study and their consent was taken before commencing the examination. Patients with severely carious, restored or missing upper first or second maxillary molars on any side were excluded.

The palatal surfaces of the mesio-lingual cusp of the left and right molars of the subjects were examined with mirror and probe for the presence or absence of the carabelli trait. When present, the carabelli trait was graded as I-IV, pit (I), groove (II), cusp without free tip (III), and well developed cusp (IV) according to the classification of Goose and Lee [6] as shown in Fig. 1. The classification of Goose and Lee is the most widely used and commonly accepted grading system of the carabelli trait as it is accurate, reproducible and simple [7].

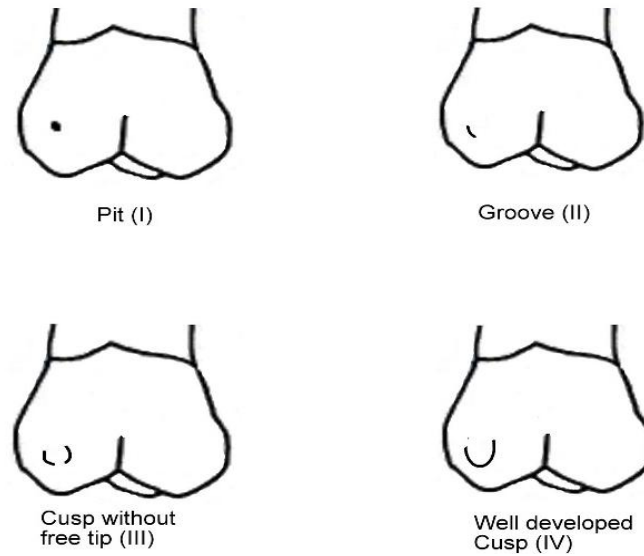


Fig. 1. Grades of Carabelli trait

When the trait was recorded as absent, the palatal surface of the mesio-lingual cusp of the upper first permanent molar was convex and smooth. When a catch was felt while moving the tip of the probe over the particular surface of the tooth, the trait was classified as a pit. When a vertical running gutter extended from the cervical margin towards the summit of the cusp was felt, the trait was classified as a groove. In the case of the carabelli cusp without free tip, the tip of the cusp was fused with the mesio-lingual cusp of the tooth and only the prominence of the tubercle was seen. This prominence was separated from the surface of the tooth by means of two curved grooves on either side of it. A well-developed cusp could be identified very easily as it projected like an additional cusp.

The findings were entered in MS excel and further analyzed by SPSS version 17.0. Chi-square was used to test for association and significant difference among the groups. P value of <0.05 was considered as statistically significant.

3. RESULTS

Among the 300 patients of 14 years or more examined, the mean age was 39.47 years with standard deviation of 16.335 years. Female patients were 151 (50.3%) and 149 (49.7%) were males.

The carabelli trait was categorized as present and absent. Grade I to IV were classified as trait present and when none was present, it was classified as trait absent. Table 1 shows the frequency of occurrence of carabelli trait in the first and second molars on either side. It is evident that 205 (68.3%) of the cases had presence of carabelli trait on either of the first molars. Further, 75 (25.0%) had carabelli trait on either of the second molars. None of the cases had the cusp only in second molars. The association of carabelli trait had no significant relation to sex ($P=.15$) as shown in Table 2.

Expression of carabelli trait was studied in each of the first and second molars (Table 3). Tooth 16 showed the presence in 190 (63.3%) cases and 26 in 166 (55.3%). The trait was present in 72 (24.0%) cases in 17 and 60 (20.0%) in 27.

The degree of expression of the cusp is shown in Table 4. In 16, only 12 (6.3%) cases had grade IV expression; the cusp as a separate entity whereas none of the cases showed grade IV expression in 17. Similarly, three (15.1%) had grade IV in 26, and none in 27 (Table 5).

As represented in Table 6, bilateral presence of the carabelli trait in 16/26 was noticed in 151 (73.7%) of the total 205 cases. Likewise, the bilateral expression in 17/27 was seen in 53 (70.7%) of the total 75 cases. The association of the trait bilaterally was significant for both the sides ($P<.001$).

Table 1. Presence of carabelli's cusp in first and second molars

Teeth	Carabelli trait	
	Present number (%)	Absent number (%)
16/26	205(68.3)	95 (31.7)
17/27	75 (25.0)	225 (75.0)
All (16, 17,26,27)	205(68.3)	95 (31.7)

Table 2. Association of carabelli's cusp with sex

Sex	Carabelli's cusp		Total	P value
	Present	Absent		
Male	96	53	149 (49.7%)	0.149
Female	109	42	151 (50.3%)	
Total	205 (68.3%)	95 (31.7%)	300 (100.0%)	

Table 3. Presence of carabelli's cusp each of the molars

Tooth	Presence of carabelli trait		Total number (%)
	Yes number (%)	No number (%)	
16	190 (63.3)	110 (36.7)	300 (100)
17	72 (24.0)	228 (76.0)	300 (100)
26	166 (55.3)	134 (44.7)	300 (100)
27	60 (20.0)	240 (80.0)	300 (100)

Table 4. Degree of expression of the cusp in 16 and 17

Grade	Right first molar (16)	Right second molar (17)
	Number (%)	Number (%)
Grade I	123 (64.7)	63 (87.5)
Grade II	27 (14.2)	6 (8.3)
Grade III	28 (14.7)	3 (4.2)
Grade IV	12 (6.3)	0 (0.0)
Total	190 (100.0)	72 (100.0)

Table 5. Degree of expression of the cusp in 16 and 17

Grade	Left first molar (26)	Left second molar (27)
	Number (%)	Number (%)
Grade I	108 (65.1)	54 (90.0)
Grade II	30 (18.1)	6 (10.0)
Grade III	25 (14.7)	0 (0.0)
Grade IV	3 (1.8)	0 (0.0)
Total	166 (100.0)	60 (100.0)

Table 6. Bilateralism of the carabelli's cusp

Tooth	Bilateralism		Total no. (%)	P value
	Present no. (%)	Absent no. (%)		
First molar (16/26)	151(73.7)	54 (26.3)	205 (100.0)	<0.001
Second molar (17/27)	53 (70.7)	22 (29.3)	75 (100.0)	<0.001

4. DISCUSSION

The study of morphologic variations of teeth is important from anthropological and forensic point of view. We can reconstruct the geographic ancestry of the people by such studies. Findings from different studies have shown very wide variation of the expression of the Carabelli trait suggesting its ethnic and racial linkage. Though the mere presence of Carabelli's trait cannot establish positive identification as it is also present in other population as well, it can obviously contribute by providing an additional parameter of the identification data. Edgar HJ [8] had also pointed out that, the commonly used traits like incisor shoveling, Carabelli's trait, canine mesial ridge, and cusp seven may not be of much actual value in ancestry determination. Combining these traits with other observations and more sophisticated statistical tools may be of more practical value. As presented by Bermúdez De Castro JM [9], marked differences were observed with respect to the incidence of the diverse degrees of expression of the trait between the Gran Canaria and Tenerife populations, whose cultural and anthropological differences are well established. The findings suggest that Carabelli's trait could be useful in establishing phylogenetic relationships between closely related populations.

In a study from Nigeria, 17.43% of the selected population had presence of Carabelli trait [10]. In the population of Saudi Arabia, the occurrence of the trait was 41.7% as shown by Syed Sadatullah et al. [11] and 57.6% as reported by Salah Al Shethri [2]. It was present in 29.7% of the study population in Pakistan, [12] 65.34 % in the contemporary study population in Hungary, [13] 61% in a study from Tehran [14] and 63.7% of permanent first molars, and 8% of permanent second molars in the target population as shown by Kamatham et al. [15] from India. Likewise 52.77% of maxillary permanent first molars displayed the trait as shown by Kannapan JG et al. [16]. A study from Croatia showed that the frequency of Carabelli's trait was significantly greater in the early modern period (51.3%) and in the 21st century (43.1%) than in the late antiquity (20.4%) and medieval periods (23.4%) [17]. Amongst Jordanian population, the prevalence of Carabelli's trait in maxillary first and second molars was 65.0% and 3.8% respectively [18]. The expression was 52.2% in Malaysian population, [19] and 65.34% in a Hungarian study [20].

Our finding shows that the Nepalese people have higher frequency of expression of the trait. Though the frequency of occurrence of the trait was higher, the cusp as a separate entity was found only in very few cases in 16 and 26 while none in 17 and 27.

Díaz E et al. [21] showed that the fossa forms of the Carabelli trait were one of the most frequent dental crown features. Fossa form of the trait was the most frequent configuration and Class 1 was the least frequent as per an Iranian study [22]. In our study too, the pit form (Class IV) was the most common finding.

Bermúdez De Castro JM [9] had presented the total trait frequency for the permanent first molar was slightly greater in males, who also showed a higher degree of expression than females though the result was not statistically significant. Significant sexual dimorphism was found in the prevalence of Carabelli's trait on maxillary first molar as observed by Khraisat A et al. [18] in a Jordanian study. No sex dimorphism in the occurrence of the trait was shown in an Malaysian study [19] and as shown by Kieser JA [23] and Harris EF [24]. Ferreria MA et al. [25] and Hsu JW et al. [26] had presented that there was a sexual dimorphism concerning the presence/absence of the trait, however there was no significant association between the degree of expression of the tubercle and the sex. Hsu JW et al. [27] in a Chinese study and Tsai PL et al. [28] in a study from Taiwan had presented that the trait was more commonly expressed in females. In our study as well, though females were more often involved, the sexual differences in the expression of the trait was not statistically different.

Bilateral presence of the Carabelli trait in upper first molars was noticed in 151 (73.7%) of the total 205 cases. Likewise, the bilateral expression in 17/27 was seen in 53 (70.7%) of the total 75 cases. It was present in 70.71 % in a Nigerian study, [8] 82.2% and 91.2% in studies from Saudi Arabia, [2,9] 75.6% in a Pakistani study [10] and 65% in a study from India. In a Malaysian study as well, bilateral occurrence with a tendency towards concordance of expression between sides was observed [22]. Iwai-Liao Y et al. [29] showed that the Carabelli tubercles on upper first molars were always bilateral. It is evident that bilateralism is very frequent in those cases where the trait is expressed.

The degree and the pattern of expression of the carabelli trait has wide variations in different countries and ethnicity. The findings are important in studying the ethnic origin of the individuals which can be useful in reconstructive dental identification procedure. The findings can also be useful in comparative dental identification when the ante-mortem photographs or the study casts are available.

5. CONCLUSION

The expression of carabelli trait in the selected Nepalese population is fairly high although frank cusp was rarely noticed. The bilateral presence of the trait was common. The study of the presence and degree of expression of the trait is implied in the determination of ethnic origin of the individuals.

ETHICAL APPROVAL

All authors declare that 'written informed consent was obtained from the patients. Ethical approval was obtained from the ethical board of College of Medical Sciences, Bharatpur.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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