



DETERMINATION OF PREVALENCE OF CARABELLI TRAIT IN DEVELOPING AGE GROUP CHILDREN OF MEWAR REGION, INDIA: A CROSS-SECTIONAL STUDY

Paediatric

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ABSTRACT

Background: Human dentition is constantly changing in its form, size, number and morphological generalizations are a part of it. Carabelli trait of maxillary molars is one such structure that is frequently considered in anthropological studies especially in developing age.

Aim and Objectives: To determine the prevalence of Carabelli trait in developing age group children of Mewar region, India.

Materials and Method: A total of 600 children, aged between 6 to 9 years of schools of Mewar region were clinically examined to determine the unilateral and bilateral presence of expression of Carabelli's trait and its involvement with dental caries in maxillary permanent first molars.

Results: The study showed a prevalence of cusp of Carabelli in males being slightly greater than females. Similarly, unilateralism was also greater in males than in females. It was concluded that more than half of the population has a degree of expression of the Carabelli structure and its involvement with dental caries.

KEYWORDS

Carabelli trait, Mewar region, developing age

INTRODUCTION

Tooth is a specialized part of the human body and understanding its development is quite enigmatic and challenging. Variations in its form, morphology and general characteristics is a common occurrence around the globe. Therefore, the term anomaly came into existence. Anomaly (Gk, *Anomalos*; irregular) is a deviation from what is regarded as normal.⁽¹⁾

Developmental dental anomalies are marked deviations from the normal color, contour, size, number, and degree of development of teeth. Both local and systemic factors are responsible for these developmental disturbances. Such influences may begin before or after birth, hence both the dentition might be affected.⁽²⁾ One such variation is the presence of Cusp of Carabelli on the primary and/or permanent molars.

The cusp of Carabelli, is also known as Carabelli tubercle, *tuberculum anmale* of Georg Carabelli. It was first described in 1842 by the Hungarian professor and dentist, Georg Carabelli. This is a morphological variation which takes the form of fifth cusp or it can grade down to a series of grooves, depressions or pits on the mesial portion of the lingual surface. This cusp is found lingual to the mesiolingual cusp of maxillary first permanent molar, which is the largest of the well-developed cusps and becomes less prominent in second and third molars.⁽³⁾ The aetiology is unknown, but it is suggested that it might be due to overactivity of dental lamina. A genetic and exogenous factor seems to have an influence on formation

Percentage distribution of Carabelli trait in different studies

Year	Investigator	Study population	Race	Percentage distribution of tooth investigated		
				PM	M1	M2
1896	Batujeff W	Russian	Mongoloids	50		
1905	De Terra M	Europeans	Caucasians	18		
1915	Bolk L	Europeans	Caucasians	61.6		
1931	Shaw JCM	Bantu race of South Africa	Negroids	3.5(skulls) 6(living)		
1938	Hirakawa W	Japanese	Mongoloids	10.7		
1944	Dietz VH	American army men	Caucasians	72.3		
1949	Pederson PO	East Greenland Eskimos	Mongoloids	0	0	
1949	Oshima S	Modern Chinese	Mongoloids	2.1		
1952	Diamond M	Mixed Europeans	Caucasians	50		
1954	Meredith HV & Hixon EH	American children of Northwestern Europe	Caucasians	84		
1957	Kallay J	Yugoslavian children	Caucasians	52.13		
1957	Moorrees CF	Aleut	Mongoloids	13.3		
1958	Tsuji	Japanese	Mongoloids	31.9		

of this cusp.⁽⁴⁾

It is a heritable feature. It has been proposed that homozygosity of a gene is responsible for a pronounced tubercle, whereas, the heterozygote show as slight grooves, pits, tubercles or bulge. It is most common among Europeans (75-85% of individuals) and rarest in Pacific islands (35.45%).⁽⁵⁾

This cusp was mainly used for differentiation between different populations but it also has significance in clinical dentistry.⁽⁶⁾ A branch of forensic anthropology also includes the examination of dental morphology and its variations with age, sex, ancestry and individual characteristics.

Mewar or Mewā is a region of south-central Rajasthan state in western India. It includes the present-day districts of Bhilwara, Chittorgarh, Rajsamand, Udaipur, Pirawa Tehsil of Jhalawar District of Rajasthan, Neemuch and Mandsaur of Madhya Pradesh and also a minute part of Gujarat.

Not many studies have been done or reported about the cusp of Carabelli and its influences in Mewar region. Therefore, the purpose of this study was to determine the prevalence of minutest Carabelli trait in permanent maxillary first molars of children age between 6-9 years of age of mewar region in India.

1963	Dahlberg AA	American whites	Caucasians	85.7
1963	Dahlberg AA	Pima Indians	Mongoloids	83.5
1966	Goaz PW	Peruvian Indians	Mongoloids	67
1967	Rosenzweig	Jews from Yemen	Caucasians	93
1967	Rosenzweig	Jews from Cochin	Caucasians	62
1967	Turner CG	Koniag Eskimos	Mongoloids	34.1
1968	Keene HJ	American whites	Caucasians	60
1970	Jien SS	Taiwanese	Mongoloids	35.5
1971	Goose GH and Lee GTR	Chinese in Liverpool	Mongoloids	29
1971	Goose GH and Lee GTR	British	Caucasians	78.8
1972	Joshi MR	Western India (Gujarat)	Caucasians	64.6
1974	Kirveskari P	Skolt Lapps	Caucasians	77.5
1975	Alvesalo L	Finnish rural polpulation	Caucasians	79
1976	Berry AC	Southeastern British	Caucasians	42.3
1976	Berry AC	Northwestern British	Caucasians	56.7
1976	Berry AC	Orkney Islanders	Caucasians	45.9
1976	Berry AC	Shetland Islanders	Caucasians	47.7
1976	Berry AC	Bonn Germans	Caucasians	60.6
1976	Berry AC	Heidelberg Germans	Caucasians	57.4
1977	Escobar V	Queckchi Indians	Negroids	54.4
1977	Liu KL	Taiwan aborigines (Ami)	Negroids	57
1977	Liu KL	Taiwan aborigines (Atayal)	Negroids	72.9
1981	Townsend GC	Australian aborginal	Negroids	80 70
1981	Kieser JA, Preston CB	Lengua indians in Paraguay	Mongoloids	70.1
1981	Kaul v, Prakash S	Jats Indians	Caucasians	61.6
1982	Saunders SR and Mayhall JT	Canadian whites	Caucasians	83.9
1982	Hassanali J	Kenyan Africans and Asians	Negroids	26-27
1983	Sharma JC	Tibetan in India	Mongoloids	5.9
1983	Scott GR	Pima Indians	Mongoloids	72.9
1984	Keiser	South Africans	Caucasians	79.2
1986	Thomas CJ	South African whites	Caucasians	82.5
1986	Thomas CJ	South African blacks	Negroids	79.2
1986	Batujeff	Russians	Caucasians	50
1992	Rusmah M	Malaysian	Mongoloids	52.2
1992	Ling YJK	Southern Chinese	Mongoloids	41.9
1992	Townsend GC, Martin NG	Asian Indians	Caucaians	86
1993	Salako et al.,	Nigerians	Negroids	78.4
1995	Guo l	Chinese	Mongoloids	20.6
1996	Tsai PL et al	Mongoloid	Mongoloids	48.07
1996	Tsai PL et al	Taiwan aborigines (Bunun)	Negroids	48.1
1996	Ooshima et al	Japanese	Mongoloids	8.3(only cusps)
1997	Hsu JW et al	Chinese	Mongoloids	36.89
1997	Hsu JW et al	Bunun aboriginal (Mongoloid)	Mongoloids	47.6
1997	Hsu JW et al	American whites	Caucasians	77.1
1997	Irish JD	Sub-Saharan African	Negroids	51.2
1998	Salako et al.,	Saudi Arabia	Caucasians	58.7
1999	Njemirovskij V	Croatian population (European) considered only 5,6,7 grade of Dahlberg	Caucasians	43.4
2000	Sousa et al.,	Brazilians	Caucasians	57.8
2001	Kanappan JG	Southern India (Chennai)	Caucasians	67.5 52.77
2002	Falomo OO	Nigerians	Negroids	17.43
2007	Edgar HJ and Lease LR	Northern American	Caucasians	60
2007	Mavrodisz K	Hungary	Caucasians	65.34
2010	King NM	Southern Chinese	Mongoloids	50.5
2010	Ferreira MA	Brazil	Mongoloids	69.5 52.1
2011	Khan DB	Pakistan	Caucasians	29.7
2011	Khraisat Ameen	Jordanians	Caucasians	65
2011	Shethri	Saudi Arabia	Caucasians	58.7
2012	Eskandari M et al.,	Guilan Iran	Caucasians	85.7
2012	Sadatullah et al.,	Saudi Arabia	Caucasians	41.7
2012	Zhou pei gang, GU yong chun	Chinese	Mongoloids	36.18 1.89
2012	Ashraf I Shaweesh	Jordanians	Caucasians	38 8
2013	Ramin Mosharraf	Iranian	Caucasians	96.6
2013	Gupta S, Saxena P	Indore, India	Caucasians	11.25
2014	K. Herman et al.,	Wroclaw, Poland	Caucasians	34.5 40,6
2014	Kamatham R et al.,	Nellore district, India	Caucasians	89.8 63.7 8
2014	Bhavsar R et al	Vadodara, India	Caucasians	

2014	Subedi N et al.,	Nepalese	Mongoloids	68.3	25
2016	Maham Niazi	Islamabad, Pakistan	Caucasians	35.1	
2016	M Kirthiga et al	Bangalore, India	Caucasians	40.5	
2016	P. Poornima	Davangere, India	Caucasians	19.5	
2017	Anca Mihaela Vitalariu et al	Athens, Greece	Caucasians	87.9	
2017	Vejdani javaneh	Rasht, Iran	Caucasians	40.3	
2017	Siddaiah S B et al	South Bangalore, India	Caucasians	33.66	

MATERIALS AND METHODS

Prior to the initiation of this study, a pilot study was conducted in which 10 subjects were randomly selected, clinically examined in the Department of Paediatric and Preventive Dentistry, Pacific Dental College and Hospital, Udaipur city. The pilot study concluded that 70% of the examined subjects had Carabelli trait on their permanent maxillary first molars.

This cross-sectional study was conducted on a total of 600 school going children of Mewar region. The sample size was selected using:

$$\frac{Z^2 \times q \times p}{d^2}$$

Z = Standard normal deviate (1.96 for 5% significance level)

p = Prevalence (70%)

q = 100 - p = 30

d = Allowance error = 5% of p = 3.5

According to the formula, sample size was found to be 558, which was rounded off to 600.

INCLUSION CRITERIA

Native children of Mewar region, of age 6-9 years with caries free permanent maxillary 1st molars were included for this study. and those with carious lesions or restorations or any developmental anomaly were excluded from the study. For the main study 600 subjects, were randomly selected from government schools of Mewar region, using multi-stage sampling technique. Ethical clearance and a written consent were taken from the parents or guardians of the subjects participating in the study. Intra-oral examination was performed on all the subjects and the permanent first maxillary molars were inspected for the presence of Cusp of Carabelli trait. Intra-oral picture of the subjects showing the trait, were taken for record keeping and statistical analysis.

RESULT

This cross-sectional study conducted on 600 school going children, between 6-9 years of age proves the prevalence of Cusp of Carabelli trait in a total of 66.1% subjects (Fig.1), with a predominance in males. Out of the 396 subjects found with the trait, 254 were males and 142 were females (Table.1, Graph.1). A variation in the unilateral and bilateral presence of the cusp was also seen among the examined subjects. 62.8% subjects showed unilateral prevalence (Fig.2) of Carabelli trait, while only 37.1% showed the bilateral presence (Fig.3). Of the total 254 males, 67.3% showed the unilateral presence of Cusp of Carabelli, whereas, out of 142 females, 54.9% showed the presence. (Table.2, Graph.2)



Fig.1 Prevalence of Carabelli trait in 66% of the population

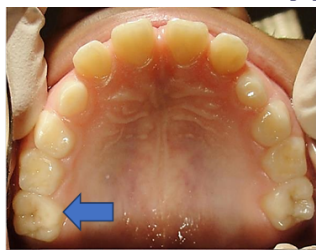


Fig.2 Unilateral prevalence of the trait in 62.8% of the population

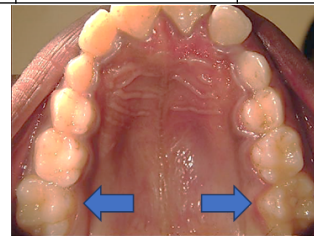


Fig.3 Bilateral prevalence of the trait in 37.1% of the population

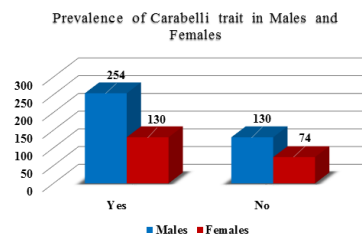
Table.1 Prevalence of the Cusp of Carabelli trait in Males and Females

Prevalence of the Cusp of Carabelli trait in Males and Females				
Gender	Cusp of Carabelli		Total	p-value
	Yes Number (%)	No Number (%)		
Male	254 (66.1)	130 (33.8)	384	0.05
Female	142 (65.7)	74 (34.2)	216	
Total	396 (66)	204 (34)	600	

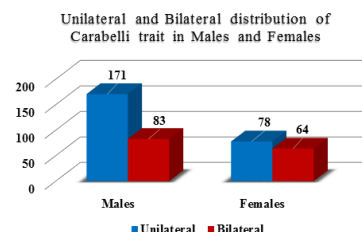
Table.2 Unilateral and Bilateral distribution of Cusp of Carabelli trait in Males and Females

Unilateral and Bilateral distribution of Cusp of Carabelli trait in Males and Females				
Gender	Cusp of Carabelli		Total	p-value
	Unilateral Number (%)	Bilateral Number (%)		
Male	171 (67.3)	83 (32.6)	254	0.001
Female	78 (54.9)	64 (45.07)	142	
Total	249 (62.8)	147 (37.1)	396	

Graph.1 Prevalence of the Cusp of Carabelli trait in Males and Females



Graph.2 Unilateral and Bilateral distribution of Cusp of Carabelli trait in Males and Females



DISCUSSION

Teeth have proven to be an extremely valuable palaeontology material to grasp the evolution of mankind. One of the first traits to be recorded in such an exploration was Carabelli's trait, as early as in 1842.(7) The trait can present as a shallow furrow or groove, a pit, a tubercle of varying size or even as a cusp with a free apex which challenges the hypocone (one of the molar's four principal cusps) in size.(7)(8) Carabelli's trait is expressed as either on the lingual surface of the protocone of the primary maxillary second molar, or the permanent maxillary first molar.(7)

Study of the morphological variations of a tooth are important from forensic and anthropological point of view. 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. Though, Edgar H.(9) pointed out that, the commonly used traits like incisor shovelling, Carabelli's trait, canine mesial ridge, and cusp seven may not be of much actual value in ancestry determination.

Until the early 19th century, prevalence of cusp of carabelli was found to be associated with tuberculosis and congenital syphilis but in a study conducted by Evelyn,⁽¹⁰⁾ stated carabelli prevalence had no association with such diseases and concluded that the presence of this extra cusp had a deep fissure that became the major site for caries occurrence in comparison to the remaining tooth structure.

Various prevalence studies contribute to the existence of this trait as being clinically important. In a study conducted in Nigeria by Folomo,⁽¹¹⁾ 17.43% of the selected population showed the presence of carabelli trait. Shethri,(12) conducted a study on 276 patients to determine the degree of prevalence of Carabelli structure in the permanent first and second maxillary molars. It was concluded that more than half of the Saudi population had a degree of expression of the trait and it was found to be associated with higher caries prevalence. Sunil et al.,⁽¹³⁾ stated that the etiology of the Carabelli cusp remains vague, with both genetic and exogenous factors contributing to its genesis. Therefore, additional care must be exercised in maintaining oral hygiene. Gauta et al.,⁽¹⁴⁾ stated that the presence of Carabelli trait varies with ethnicity and ancestry and conducted a study to determine the prevalence of Cusp of Carabelli and its association with various races. They also stated that Cusp of Carabelli may rival the main cusps in size. Kamatham et al.,⁽¹⁵⁾ concluded the prevalence to be 63.7% in permanent first molars, and 8% in permanent second molars in India. Similarly this study helps identify the group of people with higher prevalence of Cusp of Carabelli, thereby, helping in better understanding of the restorative procedures, caries prevalence, band adaptation or distortion due to the presence of an extra cusp. Though a prevalence survey on a larger scale is still required.

CONCLUSION:

The study concludes and justifies that knowledge of morphologic variations of teeth is important from anthropological aspect and helps deduce ethnic and racial linkage. The forensic aspect of this study is beneficial for the identification of races. Cavity preparation modification, orthodontic band adaptation modification and broadened occlusal table in cases of molars prevalent with cusp of carabelli, helps improve the clinical outcomes.

REFERENCES

1. Shrestha, A., Marla, V., Shrestha, S., & Maharjan, I. K. (2015). Developmental anomalies affecting the morphology of teeth—a review. *RSBO Revista Sul-Brasileira de Odontologia*, 12(1), 68-77.
2. Ardakani, F. E., Sheikha, M. H., & Ahmadi, H. (2007). Prevalence of dental developmental anomalies: a radiographic study. *Community dental health*, 24(3), 140.
3. Sarpangala, M., & Devasya, A. (2017). Occurrence of Cusp of Carabelli in Primary Second Molar Series of three Cases. *Journal of clinical and diagnostic research*: 11(3), 1.
4. Seminario-Amez, M., López-López, J., Estrugo-Devesa, A., Ayuso-Montero, R., & Jané-Salas, E. (2017). Probiotics and oral health: A systematic review. *Medicina Oral, Patología Oral Y Cirugía Bucal*, 22(3), 1.
5. Kraus, B. S. (1951). Carabelli's anomaly of the maxillary molar teeth; observations on Mexicans and Papago Indians and an interpretation of the inheritance. *American Journal of Human Genetics*, 3(4), 348.
6. Khan, D. B., Khan, M. A., & Khattak, M. (2011). Prevalence of cusp of carabelli in permanent teeth in a group from khyber Pakhtunkhwa, Pakistan. *Pakistan Oral & Dental Journal*, 31(2), 1.
7. King, N. M., Tsai, J. S., & Wong, H. M. (2010). Morphological and numerical characteristics of the southern chinese dentitions. part II: Traits in the permanent dentition. *The Open Anthropology Journal* 1(1), 1.
8. Hunter, J. P., Guatelli-Steinberg, D., Weston, T. C., Durner, R., & Betsinger, T. K. (2010). Model of tooth morphogenesis predicts Carabelli cusp expression, size, and symmetry in humans. *PLoS one*, 5(7), 1.
9. Edgar, H. J. (2009). Testing the utility of dental morphological traits commonly used in the forensic identification of ancestry. In *Comparative dental morphology*, 13(1), 49-54.
10. Evelyn S. (1922) On the significance of the extra cusp commonly found on the antero-internal aspect of the maxillary first permanent molar in men. *Journal of Scientific Research*, 1(1), 72-4.
11. Falomo, O. O. (2002). The cusps of Carabelli: frequency, distribution, size and clinical significance in Nigeria. *West African journal of medicine*, 21(4), 322-4.
12. Al Shethri, S. (2011). The prevalence of the Carabelli cusp in selected Saudi population. *King Saud University Journal of Dental Sciences*, 2(1-2), 13-16.
13. Sunil, K. V., Linga, R. N., Prabu, M., Venugopal, C., & Yella, R. C. (2013). An unusually long Meckel's diverticulum. *Journal of Evolution of Medical and Dental Sciences*, 2(19), 3275-80.
14. Gauta, I., Vazdar, M. A., & Vodanović, M. (2010). Human molar crown traits in Croatian medieval and contemporary populations. *Acta Stomatologica Croatica*, 44(1), 3-16.
15. Kamatham, R., & Nuvvula, S. (2014). Expression of Carabelli trait in children from Southern India-A cross sectional study. *Journal of forensic dental sciences*, 6(1), 51.