

FREQUENCY AND GRADING OF SUPERNUMERARY CUSPS IN PERMANENT HUMAN TEETH OF PATIENTS VISITING THE TEACHING HOSPITALS OF PESHAWAR DENTAL COLLEGE AND KHYBER COLLEGE OF DENTISTRY, PESHAWAR

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ABSTRACT

Objectives: To document the frequency and grading of supernumerary cusps in permanent teeth in patients visiting Peshawar Dental College and Khyber College of Dentistry Peshawar.

Methods and materials: A cross sectional study was carried out in which 753 patients attending the outdoor patients department who fulfilled the inclusion criteria were examined, out of which 229 (Males: 122, Females: 107) were recruited for participation in the study through consecutive sampling technique. Age group selected for the study was from 13 to 50 years. The patients were examined 4 days a week until the required sample size was accomplished. Permanent maxillary first molars and permanent maxillary incisors (central, lateral) were studied for the presence of cusp of Carabelli and Talon cusp respectively, while mandibular second premolars were examined for central cusp. Data were analyzed using SPSS version 20 and statistical analysis was done using Chi-square test.

Results: The overall frequency of supernumerary cusps was calculated to be 30.4% out of which cusp of Carabelli was 29.1% and Talon cusp was 1.33%. Gender-wise distribution was significant at $p < 0.05$. In the present study, grade III (overlapped tubercle) showed the highest degree of expression of cusp of Carabelli and type 3 Talon cusp was prevalent in our local population.

Conclusion: Amongst the reported frequency of supernumerary cusps, cusp of Carabelli occurrence was higher in our local population with a significant difference seen among genders. Central cusp was not seen in any of the subjects. There was higher incidence of cusp of Carabelli in male patients compared to Talon cusp which was more frequently present in females.

Key words: Supernumerary cusps, Cusp of Carabelli, Talon cusp, Human permanent teeth

INTRODUCTION

Development of human dentition is an extremely complex process. Any discrepancy in various stages of tooth development can result in unique manifes-

tations in that tooth.¹ These variations may be in the number, size, form or morphology.² Supernumerary or accessory cusps are one of these variations commonly found in human dentition. The excess number of cusps found in the normal dental formula are called supernumerary cusps.

The most common accessory cusps that are thoroughly reported in literature are: cusp of Carabelli in molars (52-68%), Talon cusp of incisors (1-7.7%)

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and Leong's tubercle of premolars (8%).³

The etiology of dental morphological variations is complex but genetic defects are considered to play an influential role in this regard.⁴ Anomalies of shape (Talon cusp) occur due to disturbances in morphodifferentiation and histodifferentiation stages of tooth development.⁵ During development, the primary enamel knot is the basic developmental unit, that play important role of embryonic signaling center and the genes that are involved in the developmental process of cusp formation reside in the major gene families: FGF, SHH, BMP.^{6,7}

Cusp of Carabelli (COC) is useful in forensic, anthropological and ethnic studies.⁸ According to Kamanatham, no significant sexual dimorphism either in frequency or expression of this structure has been observed.⁹ However, according to few researchers its frequency is higher in males than females. It is most common amongst Europeans (75-85 % individuals) as compared in those native to the pacific islands where its prevalence range is 35-45%.¹⁰

The Carabelli trait is an elevation, a groove or a pit, usually seen on the palatal surface of the mesio-palatal cusp of maxillary deciduous first molar and permanent maxillary first molar. It can be either present or absent but when present, it exhibits continuous variation in expression.¹¹ A pit and a groove are negative expressions of the trait, whereas a protuberance or a cusp are positive expressions.^{12,13} The pit and groove forms have clinical implications since they represent a predilection site for dental caries. The tubercle of Carabelli also interferes with banding techniques during fixed orthodontic therapy.¹⁴

In a local study conducted by Khan et al (2011),¹⁵ the frequency of cusp of Carabelli was found to be 29.7%. In another local study, 32% of study population had cusp of Carabelli with unilateral presentation in maxillary first molars.¹¹ Similarly, the frequency of cusp of Carabelli was low (35.1%) in a population sample of Islamabad than other Asian samples.¹⁶

The second commonly found accessory cusp is Talon cusp (TC). It is a morphologically well-delineated accessory cusp-like structure projecting from the cemento-enamel junction towards the incisal ridge of the anterior teeth. The term talon cusp was coined by Mellor and Ripa due to its resemblance to an eagle's talon.¹⁷ Hattab et al., classified this

anomaly in to three different types i.e. Type 1, Type 2, Type 3.¹⁸ The exact cause of talon cusp is yet to be known.¹ The reported prevalence is between 0.06% in Mexican and 7.7% in North Indian population predominantly in males.¹⁸

Another type of cusp is called "Central cusp," also known as "occlusal supernumerary cusp" or "Dens Evaginatus". It was referred to as Leong's premolar after the first description given by MO Leong in 1946. It is common among Mongoloid races and rare in Whites and Asians. Central cusps have subsequently been described by many authors in different forms, on premolars, molars, incisors and canines. Schulze (1987) classified posterior central cusp (Dens Evaginatus) into five types.^{19,20}

Studies have been conducted in the past related to these supernumerary cusps in our region but no such study has been conducted in which the frequency determination of all these supernumerary cusps are done collectively along with the degree of expression of their respective trait form. Therefore, this study is carried out to determine the frequency and expression of various trait forms of 3 types of supernumerary cusps in our local population

The objectives of the study are to document the frequency of supernumerary cusps in patients visiting the outpatient's department of Peshawar Dental College and Khyber College of Dentistry, Peshawar and also determine the various forms of Supernumerary cusp traits.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted on patients who attended the outpatients department of Peshawar Dental Hospital and Khyber College of Dentistry. Before commencing the examination, the details of the study were explained to the patients and were informed about the study purpose. Written consent from each patient was taken on a specially designed form (Annexure-B). The study was approved by the ethical committee of Peshawar medical college, Peshawar and Riphah International University, Islamabad.

A Specifically designed proforma was used for recording the data. All patients who fulfilled the inclusion criteria were examined for the presence and absence of Carabelli trait, Talon cusp and Central cusp. A total of 753 patients were recruited for par-

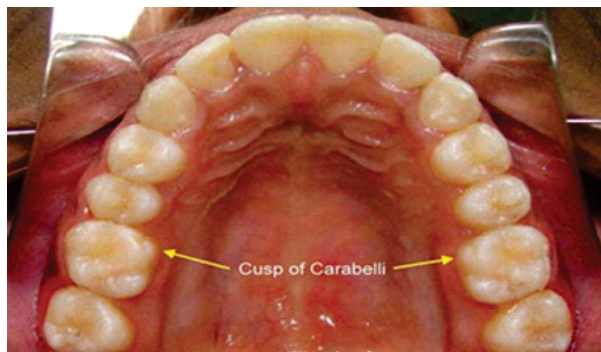


Fig 1: Cusp of Carabelli

participation in the study. Thorough clinical examination of the required teeth was performed using mouth mirror and dental explorer in the dental chair. Grading of Carabelli cusp is given in table I, according to the classification given by Goose and Lee.

Talon cusp is classified into type 1, type 2, type 3 according to the classification system proposed by Hattab et al., 1996.

The patient's data on filled proforma were analyzed using computer program SPSS version 20. Significant variation from the mean was computed using Pearson's chi square test. Gender wise distribution of supernumerary cusps is calculated by using Fisher exact test. The p-value was considered significant at ≤ 0.05 .

RESULT

A total number of 753 patients (male: 360, female: 393) fulfilling the criteria of the study were examined in the OPD of Peshawar dental college (116 patients) and Khyber college of dentistry (637 patients), out of which 229 patients (30.4%) were included in the study having supernumerary cusps. The overall frequency of Carabelli cusp was calculated to be 219 out of 753 patients (29.1%). The frequency of second supernumerary cusp (Talon) was calculated to be 10 out of 753 patients (1.33%). These values show a significant result (Table III). In none of the subjects, the Central cusp was seen.

The chi-square statistic is 3.941. The p-value is .047. This shows a significant relationship of supernumerary cusps to gender (Table IV).

The Carabelli trait is categorized as present or absent. When present, it is classified from grade I to IV. The degree of expression of COC is shown in table V.

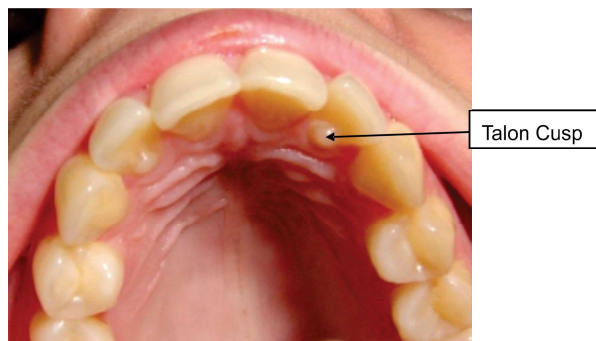


Fig 2: Fig. 2: Talon cusp

In the present study, grade III (overlapped tubercle) showed the highest degree of expression of COC i.e. 84 cases out of 219 while the lowest expression recorded was of grade I i.e. 23 cases out of 219. Degree of expression of Carabelli trait was higher in male patients as compared to female patients. The association of expression of Carabelli trait had no significant relation to gender. (Table V).

In this study 10 patients were detected with talon cusps, out of which 7 were female patients and 3 were male patients. Person prevalence is 1.33% while gender wise prevalence of talon cusp is 1.78% for female gender (7 out of 393) and 0.833% for male gender (3 out of 360). Type 3 talon cusp is found more prevalent in our local population i.e. 5 patients out of 10 were having type 3 talon cusp. The expression of type 1 talon is low i.e. 1 out of 10 patients detected with talon. Chi-square was not significant at $p=0.270$. The chi-square statistic is 2.62. This result is not significant at $p < 0.05$ shown in Table VI.

DISCUSSION

In the present study, the overall frequency of the supernumerary cusps (Carabelli, Talon) was 30.4% (Table III). The age group studied was from 13 to 50 years with a mean age of 27.54 ± 8.6 . The result for supernumerary cusps was significant ($P < .05$). Different authors have used different age groups in their studies worldwide like 11-55 years,¹⁴ 15-20 years,²¹ 15-49 years,²² 17-21 years.⁸ Total 753 patients were examined in OPD of two dental teaching hospitals of Peshawar who fulfilled the inclusion criteria, out of which 229 were having supernumerary cusps, (219 were having COC and 10 patients were having Talon cusp (TC)). In this study, not a single patient was found having both types of cusps together. Similar findings were reported by Kaviani²⁴ and observed 214 cases of COC and 17 cases of Talon cusp out

of total 356 cases and Mavrodisz²³ who found 393 subjects with COC and 15 with Talon cusps out of total 600. The authors of the study also compared the incidence and expression of COC and Talon cusp of contemporary patient group (600 subjects) with 11th century skulls (147 well preserved skulls).

When all likely forms of COC is considered on permanent maxillary first molar in the present study, the total frequency calculated was 29.1% in our locality (219 patients exhibit COC out of 753 recruited patients, (Table I). Similar results (29.7%) were found in a study conducted by Khan et al., (2011)¹⁵ in a hospital based study in Khyber Pakhtunkhwa population with a sample size of 400 patients. Niazi et al (2016)¹⁶ observed a prevalence of 35.1% in patients visiting the orthodontic department of Islamabad Dental Hospital (sample size of

698 pre-treated maxillary casts). Similarly, in a study by Qamar et al, (2018),¹¹ the overall frequency of COC was reported to be 32% with a study sample of 100 patients having an age group of 11-55 years.

The results of the present study (COC) were in approximation with the results given by Mukhopadhyay and Mukhopadhyay (2020) in permanent maxillary first molars by direct clinical examination (sample of 377 children in Bengali population with an age range of 6-11 years) and Hassan et al., (2019) on maxillary casts of 400 Kashmiri individuals with a prevalence rate of 23.1%, 25% respectively.¹² Indian population displayed a prevalence of 30.7% in a study conducted by Kamatham and Nuvula (2014).⁹

Contrary to the results of the present study, Masud et al., (2018)²⁵ studied tooth morphological vari-

Table 3: Frequency of distribution of various Supernumerary cusps in the study subjects (N = 753)

| Supernumerary cusps | Present (%) | Absent (%) | Total (%) | Chi-Sq2 Value | Significance p<0.05 |
|-------------------------|-------------|--------------|------------|---------------|---------------------|
| Cusp of Carabelli (COC) | 219 (29.1%) | 534 (70.9%) | 753 (100%) | 131.77 | <.001 |
| Talon cusp (TC) | 10 (1.33%) | 743 (98.67%) | 753 (100%) | 713.63 | <.001 |

Table 4: Gender wise distribution of supernumerary cusps (N = 753)

| Gender | Supernumerary cusps | Absent (%) | Total (%) | Chi-Sq2 Value | Significance p<0.05 |
|--------|---------------------|--------------|------------|---------------|---------------------|
| Male | 122 (33.89%) | 238 (66.11%) | 360 (100%) | 3.941 | 0.047 |
| Female | 107 (27.23%) | 286 (72.77%) | 393 (100%) | | |

Fisher exact test p =.048

Table 5: Degree of expression of COC (N = 219)

| Grading of COC | Male | Female | Frequency | Percent | Chi-sq2 value | Significance P<0.05 |
|---------------------------------|------|--------|-----------|---------|---------------|---------------------|
| Pit (Grade I) | 12 | 11 | 23 | 10.5 | 0.695 | 0.874 |
| Groove (Grade II) | 25 | 25 | 50 | 22.8 | | |
| Overlapped tubercle (Grade III) | 48 | 36 | 84 | 38.4 | | |
| Free tubercle (Grade IV) | 34 | 28 | 62 | 28.3 | | |
| Total | 119 | 100 | 219 | 100.0 | | |

Table 6: Gender-wise distribution of types of talon cusp

| Types of Talon cusp | Male | Female | Total | Chi-sq2 value | Significance P-Value |
|---------------------|--------|----------|----------|---------------|----------------------|
| Type 1 | 1(10%) | 0(0) | 1(10%) | 2.62 | 0.270 |
| Type 2 | 1(10%) | 3(30.0%) | 4(40%) | | |
| Type 3 | 1(10%) | 4(30.0%) | 5(50%) | | |
| Total | 3(30%) | 7(70%) | 10(100%) | | |

Table 1: Classification of COC by Gouse and Lee, 1971

| | |
|-----------|---|
| Grade I | When the explorer tip felt catch, over the lingual surface of mesio palatal cusp, it is measured as a pit |
| Grade II | When a vertically running trough is noted, extending from the cervical margin to the summit of cusp is termed as groove |
| Grade III | When COC tip is fused with mesio palatal cusp of the tooth and tubercle prominence is seen, it is considered as overlap COC |
| Grade IV | An additional well defined tubercle on the lingual surface of mesio palatal cusp is considered as free cusp or COC |

ations on maxillary casts of 300 school students from 3 ethnic groups with an age range of 12-21 years for morphological variations of teeth and observed 71% frequency of COC in maxillary 1st molars. Studies by Agnihotri et. (2013),⁸ Smitha et al., (2018)²⁶ and Kamatham et al., (2014)⁹ shows 78.5%, 87% and 63.7% frequency of COC in Indian population.

Variable frequencies are reported in the studies worldwide e-g amongst Nepali population, 68.3% prevalence of COC was observed by Subedi et al., (2015), 52.88% in Bangladeshi population (Sarkar S 2019).¹⁴

As the results of the above mentioned studies suggests that in some populations, the incidence of Carabelli trait is higher while in others it is low therefore, in order to evaluate the heritability of Carabelli cusp, conflicting results have been observed worldwide.

Gender wise distribution of supernumerary cusps shows higher incidence in male gender (33.89%) as compared to females (27.83%). A significant relationship is seen between supernumerary cusps and gender. (Table IV)

The present study showed (table V) a statistically non-significant distribution of cusp of Carabelli between both sexes ($p > 0.05$). Although, the degree of COC expression in the present study is higher in males (54.3%) as compared to female patients (45.7%) (Table V). The frequency of grade III expression is higher in the present study while grade I shows the lowest frequency, which is contrary to the findings of Diaz E et al., 2006 and Subedi et al., 2014.¹⁴ In these previously mentioned studies, the pit form was the most prevalent form of COC expression.

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 cemento-enamel junction |
| Type 2 | The cusp covers less than half of the distance between the incisal edge and the Cemento-enamel junction but it is larger than 1 mm |
| Type 3 | A small tubercle located on the gingival third of the tooth. It can be V, T or Y shaped |

Concerning Talon cusp, this data has taken 1.33% (10 patients of Talon cusp out of 753 recruited patients) of the total supernumerary cusps frequency (Table III). Some researchers had showed higher frequency in their studies. In the present study, the assessment of Talon cusp was made only on permanent anterior Incisor teeth, thus talon cusp frequency in deciduous teeth however, has to be explored.

The frequency of Talon cusp varies amongst populations and races. Its frequency was stated for instance in Nigerians population 0.3% (Temilola et al, 2014),²⁷ Indians 0.58% (Prabhu et al, 2012),²⁸ Turkish 0.34% (Guyen et al, 2016).²⁹ However, the frequency presented in the current study is higher than the above mentioned studies. While the studies conducted by King et al (2010) in China, Mavrodisz et al (2007) in Hungary, Luke et al (2017) in UAE, Yassin, SM. (2016) in Saudi Arabia and Hamasha & Safadi (2010) in Jordan reported the prevalence of 2.5%, 2.5%, 2.3%, 1.4% and 2.4% respectively.^{2,23, 30,31,35} These values are in near concordance to the frequency value reported in the present study.

The present study Talon cusp occurrence is much lower (1.33%, Table III) than the prevalence reported in Portuguese (6.3%)³² and Turkish population (8.86%).³³ These differences in results may arise due to variations amongst states, different ethnic groups, sub-races and populations investigated.

In the current study, Table VI shows that female patients were more affected with talon cusp (70%) as compared to male patients (30%), This may propose a sex related genetic element that act as an important causative factor in talon cusp occurrence³⁴ however in this study, no significant sex preference is observed as $p > 0.05$, this was in agreement with Hamasha et al³⁵ who did not find significant sex predilection in

his study.

As shown in table VI, the expression of type 3 talon is higher in the current study (5 out of 10 patients). Talon cusp occur on both permanent maxillary central and lateral incisors, however the frequency is higher on permanent maxillary lateral incisor. In the current study, few patients with talon cusp were presented with associated complications in form of dental carries, premature contact and occlusal interference due to the presence of talon cusp.

The prevalence and morphology of accessory cusps can be responsible for answers to many queries, like division of a population into western or eastern type dentition or the combination of races within a population

Consequently, the aspects accountable for the expression and distribution of the supernumerary cusps in different races are very essential to be studied. Environmental and genetic factors are considered as the main contributing factors for the wide variations in the geographic distribution of the accessory cusps.

Due to the deficient epidemiological information available, the precise prevalence of these anomalous accessory cusps is not known. As the present sample size was not a definite representation of entire Pakistani population, therefore, the results may vary in other studies with different study design. Therefore, further studies should be conducted regarding the degree of expression of these supernumerary cusps.

CONCLUSION

Our study result showed the frequency of supernumerary cusps, cusp of Carabelli occurrence was higher in local population. Significant difference was seen among gender with the presence of supernumerary cusps while Central cusp was not seen in any of the subjects and there was higher incidence of cusp of Carabelli in male patients compared to talon cusp which was more frequently present in females in the present study. Similarly, the frequency of grade III trait expression was higher in case of COC while in case of talon cusp Type 3 trait expression is more prevalent.

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