

Presence and Morphology of the Molar Tubercle According to Dentition, Hemi-Arch and Sex

Presencia y Morfología del Tubérculo Molar de Acuerdo con la Dentición, Hemiarco y Género

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SUMMARY: The purpose of this study was to assess the presence and the degree of expression of the molar tubercle according to sex, dentition and hemi-arches. Study casts of 126 patients were assessed, and those were under orthodontic treatment at the University of Franca, UNIFRAN; they were from both sexes, from 4 to 13 years old. The upper second primary molars and the upper first permanent molars, from both sides, were evaluated regarding the presence and the degree of expression of the molar tubercle. For an association study, the qui-square test was utilized. The concordance about the presence or absence of the molar tubercle according to dentition, hemi-arch and sex, was estimated by the Kappa Statistics. There was a sexual dimorphism concerning the presence/absence of the molar tubercle ($p=0.009$), however there was no significant association between the degree of expression of the tubercle and the sex ($p=0.791$). The molar tubercle was more frequently observed in the male sex, in upper second primary molars and in the form of depression. There was a significant and “moderate” concordance between the left and right sides in primary dentition ($k=0.596$), there was a “good” concordance in permanent dentition ($k=0.708$) and a “weak” and significant concordance between the presence of the molar tubercle and dentition ($k=0.207$).

KEY WORDS: Molar; Tooth crown; Permanent dentition; Primary dentition.

INTRODUCTION

The molar tubercle is an anatomic structure frequently found in first permanent molars and upper second primary molars. However, it is reported its presence in upper second and third permanent molars. The molar tubercle is generally observed bilaterally on the palatine face of the mesio-palatine cusp of the teeth above mentioned (Sousa *et al.*, 2000).

Different denominations can be attributed to this anatomic structure, such as: enamel elevation, fifth cusp, accessory cusp, mesiolingual prominence, Carabelli cusp and Carabelli tubercle (Meredith & Hixon, 1954), being the last one the most usually used. Nevertheless, due to the elimination of the eponyms of anatomical nomenclature, the current denomination of this structure is molar tubercle.

In the study of Sousa *et al.*, it was identified a higher occurrence of the molar tubercle in males, and so associated

to the crowns of bigger upper first and second permanent molars, with four cusps, and there was no significant difference on the presence of the tubercle and the hemi-arches. Notwithstanding, in the study of Townsend & Martin (1992), performed in twins from the South of Australia, there was no heterogeneity on the molar tubercle between male and female, for both sides, so indicating the absence of sexual dimorphism. A similar result was found by Rusmah (1992) when he assessed the presence of the molar tubercle in children from Malaysia.

The form of expression of the molar tubercle can vary from foveae to the morphology of a cusp, passing through intermediate degrees of expression.

The morphological variations of the molar tubercle make it an important study object. Its morphology can be

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significant for the diagnosis and risk of carious lesion, in the cases of anthropological studies and those related to Forensic Dentistry.

The purpose of this study was to assess the presence and degree of expression of the molar tubercle according to sex, dentition and hemi-arches.

MATERIAL AND METHOD

This work received the approval of the Committee of Ethics on Research from the University of Franca, UNIFRAN (043/08). Study samples of 126 individuals were assessed, and they were under orthodontic treatment at the University of Franca, UNIFRAN, being from both sexes, from 4 to 13 years old.

The upper second primary molars and upper first permanent molars, from both sides, were assessed concerning the presence and degree of expression of the molar tubercle. For such assessment, it was used the classification of Sousa *et al.*, that preconize the following degrees: (0) absent tubercle, (1) depression – for the surfaces that have a fovea which is associated or not to grooves, (2) mild – when it has a mild prominence and (3) prominent – when this prominence is more developed.

The casts were assessed by a trained examiner, under artificial lighting and naked eye. Afterwards, the examiner (a graduation student) and an Anatomy professor evaluated, independently, 108 teeth, with the purpose of studying the inter-examiners concordance.

A descriptive statistics was performed, and for the study of the associations of interest, the qui-square test was done. In order to estimate the inter-examiners concordance, and the absence or presence of the molar tubercle in different hemi-arches and dentitions, it was used the Kappa Statistics by score (k) and by 95% of confidence interval (IC_{95%}). The significance level used was 5%.

RESULTS

The middle age of the children, from whom casts were assessed, was 7.72±1.88 years old, being 51.47% male. From the 126 individuals assessed altogether, 402 teeth were analyzed, being 210 primary teeth and 192 permanent teeth.

In the assessment of the presence and degree of

expression of the molar tubercle, it was observed an “Optimal” inter-examiner concordance (k=0.86; IC_{95%}: 0.78-0.93).

In Tables I and II, it can be observed the distribution of the presence/absence and degree of expression of the molar tubercle, respectively, according to sex.

A significant association was observed between sex and the presence or absence of the tubercle ($\chi^2=6.784$; p=0.009), with a higher frequency of male individuals with molar tubercle, and a non-significant association between the degree of expression of the molar tubercle and sex ($\chi^2=0.469$; p=0.791).

Table I. Distribution of the presence and absence of the molar tubercle in teeth assessed according to gender.

Gender	Tubercle		Total
	Absent	Present	
Female	88	106	194
Male	68	140	208
Total	156	246	402

Table II. Distribution of the degree of expression of the molar tubercle of the teeth with the presence of the tubercle according to gender.

Gender	Tubercle			Total
	Depression	Mild	Prominent	
Female	77	21	8	106
Male	101	31	8	140
Total	178	52	16	246

The distribution of the assessed teeth, according to dentition and degree of expression of the molar tubercle, can be observed in Table III.

A significant association is observed between the presence of the tubercle and dentition ($\chi^2=12.847$; p=0.001), being the primary dentition the most affected.

Table III. Distribution of the molars assessed according to the type of dentition and degree of expression of the molar tubercle.

Tubercle	Dentition. n (%)	
	Primary	Permanent
Absent	64 (30.48)	92 (47.91)
Depression	120 (57.14)	58 (30.21)
Mild	18 (8.57)	34 (17.71)

In Table IV, there is the distribution of the presence and absence of the molar tubercle in primary teeth, observing the right and left sides of the same individual, considering that 105 individuals showed, simultaneously, the upper second primary molars of the right and left side.

It can be observed a “Mild” and significant concordance between the presence of the molar tubercle and the sides of the assessed tooth in primary dentition ($k=0.596$; $IC_{95\%}: 0.428-0.763$; $p=0.001$).

Table IV. Presence and absence of the molar tubercle in primary teeth considering the right and left sides of the same individual.

Tubercle	Tooth 65		Total
	Absent	Present	
Tooth 55			
Absent	23	9	32
Present	9	64	73
Total	32	73	105

The simultaneous presence of the upper first permanent molars, on the right and left sides, was observed in 96 individuals. In permanent teeth, there is a “Good” and significant concordance ($k=0.708$; $IC_{95\%}: 0.567-0.850$; $p=0.001$) between the presence of the molar tubercle and the hemi-arch (Table V).

Table V. Presence and absence of the molar tubercle in permanent teeth considering the right and left sides of the same individual.

Tubercle	Tooth 26		Total
	Absent	Present	
Tooth 16			
Absent	39	5	44
Present	9	43	52
Total	48	48	96

In Table VI, the distribution of the presence and absence of the molar tubercle is found in different dentitions of the same individual, considering that 75 individuals showed, simultaneously, primary and permanent teeth.

It was observed a “Weak” and significant concordance ($k=0.207$; $IC_{95\%}: 0.000-0.483$; $p=0.015$) between the presence of the molar tubercle and the type of dentition.

Table VI. Presence and absence of the molar tubercle in the primary and permanent dentitions of the same individual.

Dentition	Permanent		Total
	Absent	Present	
Primary			
Absent	10	4	14
Present	24	37	61
Total	34	41	75

DISCUSSION

In this study, it was assessed the presence and the degree of expression of the molar tubercle in second primary molars and first permanent molars, so not being possible the observation of the same in second permanent molars, due to the age of the assessed individuals. According to Scott (1979), the molar tubercle is positively associated with the first and second permanent molars; however this association is stronger regarding the first molars.

The presence of the tubercle was observed in 69.52% of the second primary molars and in 52.09% of the first permanent molars assessed. A similar result was found in the studies of Sousa *et al.* (57.58%) and Rusmah (51.6%) for first permanent molars, while a higher frequency was found by Meredith & Hixon (84%), Alvesalo *et al.* (1975) (79%) and Townsend & Martin (85%).

In Table I, it is observed a sexual dimorphism which is related to the presence or absence of the molar tubercle, being the higher prevalence in male individuals, such fact being also found in the studies of Tsai *et al.* (1996) and Sousa *et al.*, however being different from those found by other authors (Garn *et al.*, 1966; Biggerstaff, 1973; Scott; Rusmah).

Despite the sexual dimorphism related to the presence or absence of the molar tubercle verified in this study, a non-significant association was observed between sex and degree of expression of the tubercle (Table II), confirming other findings from literature (Alvesalo *et al.*; Saunders & Mayhall, 1982; Thomas *et al.*, 1986; Rusmah; Townsend & Martin), different from Sousa *et al.*, who found the influence of sex in the occurrence as well as in the expression of the tubercle.

Thus, it is verified that the sexual dimorphism related to the molar tubercle changes among the different studies and populations. According to Noss *et al.* (1983), who observed a mild degree of sexual dimorphism related to the molar tubercle, the dental morphological characteristics that do not show any differences between sexes, are probably influenced by the size of dental crown.

In the present study, the way of expression most frequently found was the depression, in primary teeth (57.14%) as well as in permanent teeth (30.12%), followed by a mild prominence. The prominent form was the least observed, and the absence of tubercle was observed in 30.48% of the primary teeth and in 47.91% of the permanent teeth so assessed (Table III). Joshi (1975) also found higher percentages for the form of depression in second primary molars (66.1%). It was also verified the percentage of 12.4%

in the form of mild prominence, 9.7% for pronounced prominence and only 11.8% showed the absence of tubercle, different from the frequency so observed in this study. Different frequencies were observed by Sousa *et al.*, being the mild prominence (31.05%) the most frequent form, followed by the prominent form (13.45%) and by the depression (13.06%).

It was verified that the right and left sides showed to be correspondent relating to the presence/absence of the molar tubercle, in the primary teeth (Table IV) as well as in the permanent teeth (Table V). A similar result was found by Sousa *et al.*, who stated a similarity between the right and left sides in the occurrence and expression of the tubercle. Those findings also confirm the studies of Alvesalo *et al.*, Thomas *et al.* and Rusmah, and they disagree with the results of Meredith & Hixon, who verified discordance between the morphology of the tubercle on the right and left sides in 70% of the individuals.

It was also observed a “weak” and significant concordance between primary tooth (second molar) and permanent tooth (first molar) relating to the presence/absence of the molar tubercle (Table VI). The degree of expression of the tubercle for first permanent molars, was

not independent in relation to the second primary molars in the study of Thomas *et al.* and, according to Joshi, the molar tubercle appears on the second primary molar if it is also present on the first permanent molar.

According to Saunders & Mayhall, it must be also considered the presence of morphogenetic factors of expression of the tubercle in primary and permanent teeth. Nevertheless, Biggerstaff affirmed that the molar tubercle does not express a high degree of heredity, so agreeing with Alvesalo *et al.*, who suggested that the variation in the expression of the tubercle is not related to genetic factors. Notwithstanding, Townsend & Martin verified an estimative of heredity at about 90%, so indicating a strong genetic contribution related to the molar tubercle.

A sexual dimorphism was verified concerning the presence/absence of the molar tubercle, so being more frequently observed in males, in second primary molars and in the form of depression. Regarding the presence/absence of the molar tubercle, there was a “mild” concordance between the right and left sides in primary dentition and a “good” one in permanent dentition. The concordance observed between the presence or absence of the tubercle in different dentitions was “weak”.

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RESUMEN: El objetivo de este estudio fue evaluar la presencia y el grado de expresión del tubérculo molar de acuerdo con el sexo, dentición y hemiarcos. Fueron evaluados modelos de estudio de 126 pacientes que estaban bajo tratamiento ortodóntico en la Universidad de Franca, UNIFRAN, de ambos los sexos, de 4 a 13 años de edad. Los segundos molares superiores primarios y primeros molares superiores permanentes, de ambos los lados, fueron evaluados cuanto la presencia y el grado de expresión del tubérculo molar. Para estudio de asociación, se utilizó el test de Qui-cuadrado. La concordancia de la presencia o ausencia del tubérculo molar segundo dentición, hemiarco y sexo fue estimada por la Estadística Kappa. Se observó dimorfismo sexual cuanto la presencia/ausencia del tubérculo molar ($p=0,009$), todavía no hubo asociación significativa entre el grado de expresión del tubérculo y el sexo ($p=0,791$). El tubérculo molar fue más frecuentemente observado en el sexo masculino, en segundos molares primarios y en la forma de depresión. Se verificó concordancia significativa y “moderada” entre los lados derecho e izquierdo en la dentición primaria ($k=0,596$), “buena” en la dentición permanente ($k=0,708$) y concordancia “débil” y significativa entre la presencia del tubérculo molar y el tipo de dentición ($k=0,207$).

PALABRAS CLAVE: Diente molar; Corona del diente; Dentición permanente; Dentición primaria.

REFERENCES

- Alvesalo, L.; Nuutila, M. & Portin, P. The cusp of Carabelli. Occurrence in first upper molars and evaluation of its heritability. *Acta Odontol. Scand.*, 33(4):191-7, 1975.
- Biggerstaff, R. H. Heritability of the Carabelli cusp in twins. *J. Dent. Res.*, 52(1):40-4, 1973.
- Garn, S. M.; Kerewsky, R. S. & Lewis, A. B. Extent of sex influence on Carabelli's polymorphism. *J. Dent. Res.*, 45(6):1823, 1966.
- Joshi, M. R. Carabelli's trait on maxillary second deciduous molars and first permanent molars in Hindus. *Arch. Oral Biol.*, 20(10):699-700, 1975.

- Meredith, H. V. & Hixon, E. H. Frequency, size, and bilateralism of Carabelli's tubercle. *J. Dent. Res.*, 33(3):435-40, 1954.
- Noss, J. F.; Scott, G. R.; Potter, R. H.; Dahlberg, A. A. & Dahlberg, T. The influence of crown size dimorphism on sex differences in the Carabelli trait and the canine distal accessory ridge in man. *Arch. Oral Biol.*, 28(6):527-30, 1983.
- Rusmah, M. The cusp of Carabelli in Malaysians. *Odontostomatol. Trop.*, 15(1):13-5, 1992.
- Saunders, S. R. & Mayhall, J. T. Developmental patterns of human dental morphological traits. *Arch. Oral Biol.*, 27(1):45-9, 1982.
- Scott, G. R. Association between the hypocone and Carabelli's trait of the maxillary molars. *J. Dent. Res.*, 58(4):1403-4, 1979.
- Sousa, E. M. D.; Carvalho, L. F. P. C. & Pereira, L. L. Prevalência do tubérculo de Carabelli no primeiro molar superior. *Rev. Fac. Odontol. Odontol. Univ. Fed. Bahia*, 20:6-10, 2000.
- Thomas, C. J.; Kotze, T. J. & Nash, J. M. The Carabelli trait in the mixed deciduous and permanent dentitions of five South Africans populations. *Arch. Oral Biol.*, 31(3):145-7, 1986.
- Townsend, G. C. & Martin, N. G. Fitting genetic models to Carabelli trait data in South Australian twins. *J. Dent. Res.*, 71(2):403-9, 1992.
- Tsai, P. L.; Hsu, J. W.; Lin, L. M. & Liu, K. M. Logistic analysis of the effects of shovel trait on Carabelli's trait in a Mongoloid population. *Am. J. Phys. Anthropol.*, 100(4):523-30, 1996.

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