CORRELATION BETWEEN CUSP PATTERN AND DEFLECTING WRINKLE IN SIX ETHNIC GROUPS FROM SOUTHWESTERN COLOMBIA

LINA PARRA[1], JESÚS ALBERTO HERNÁNDEZ[2], SANDRA MORENO[3], FREDDY MORENO[4]

ABSTRACT. Introduction: *the cusp pattern and the deflecting wrinkle are two morphological traits whose expression and variability contribute to the morphological configuration of the occlusal surface of deciduous and permanent lower molar teeth. The objective of the present study was to estimate the correlation between cusp pattern and deflecting wrinkle in six ethnic groups from southwestern Colombia.* ***Methods:*** *analysis of 480 plaster models corresponding to 100 mixed Caucasoid mestizos from Cali (50 men and 50 women), 60 Afro-descendants from Cali (34 women and 26 men), 84 Afro-descendants from Puerto Tejada (42 women and 42 men), 116 Afro-descendants from Villa Rica (57 men and 59 women), 60 misak indigenous (37 women and 23 men) and 60 nasa indigenous (35 women and 25 men).* ***Results:*** *there were high frequencies (over 60%) of cusp pattern (Y expression) and deflecting wrinkle (grades 2 and 3) in deciduous first lower molars, mid frequencies (between 40 and 59%) of cusp pattern (Y and + expressions) and deflecting wrinkle (grades 1 and 2) in permanent first lower molars, and mid frequencies (between 40 and 59%) of cusp pattern (+ and X expressions) and deflecting wrinkle (grades 1 and 2) in permanent lower second molars.* ***Conclusions:*** *these frequencies suggest a trend in cusp pattern, which may vary according to the degree of expression of the deflecting wrinkle. This tendency consists of the Y cusp pattern when the deflecting wrinkle is expressed in grades 2 and 3. Bilaterally was observed and there was no sexual dimorphism.*

Key words: *dental components, cusp pattern, deflecting wrinkle, populations from southwestern Colombia*

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[1] DMD, Specialist in Oral Rehabilitation, Graduate Criminology student, School of Law, Political and Social Sciences, Universidad Libre (Cali, Colombia)

[2] DMD, Specialist in Comprehensive Dentistry of the Child and Maxillary Orthopedics, Professor at the School of Dentistry, School of Health, Universidad del Valle (Cali, Colombia)

[3] DMD, MA in Biomedical Sciences, Professor at the Department of Basic Health Sciences, School of Health Sciences, Pontificia Universidad Javeriana (Cali, Colombia)

[4] DMD, MA in Biomedical Sciences, Professor at the Department of Basic Health Sciences, School of Health Sciences, Pontificia Universidad Javeriana (Cali, Colombia)

INTRODUCTION

A review of the dental, anthropological, and forensic literature shows that research on dental morphology by observation, recording, and analysis of tooth crown morphological patterns (TCMP)—like biological markers—has focused, respectively, on the clinical role of morphological expressions as an etiological factor of caries by bacterial plaque retention; the anthropological study of past and present peoples to clarify their history, origin, training, contacts, travels, and isolations, and supporting the processes of forensic identification in reconstructing the odonto-biography of an individual.[1-4]

Two of the TCMP's most commonly studied are deflecting wrinkle and cusp pattern, whose expression contributes to the morphological configuration of the occlusal surface of deciduous and permanent lower molars. Due to their high taxonomic value, these traits have been used in the estimation of biological relationships among different human groups based on frequency, bilateralism, and sexual dimorphism. However, few studies have correlated the expression of TCMP's with each other, focusing mainly on the correlation of the expression of a same morphological trait in different teeth, in order to understand the behavior of the morphogenetic fields during the odontogenesis of bifiodontia (dental system consisting of deciduous and permanent dentitions).[5-7]

However, the correlation of the expression of two TCMP's in a same tooth could explain the way the molar morphogenetic field sets the pattern of cusps and grooves from the centers of growth (enamel knots), and the way in which the main and secondary slopes of the primary grooves are phenotypically modeled. Therefore, the objective of this study was to correlate the expression of cusp pattern and deflecting wrinkle in six southwestern Colombian ethnic groups, participating in the debate on the phylogenetic mechanisms that shape the morphological variability of the tribosphenic quadritubercular molar.

Cusp pattern

The lower molars' cusp pattern refers to the way the main cusps are related (and contact each other) through the main grooves. This TCMP was first described by Gregory in 1916,[8] classified by Hellman between 1926 and 1928,[9] and finally incorporated in the Arizona State University Dental Anthropology System (ASUDAS) by Turner II et al in 1991,[10] identifying its variability in different human populations (Table 1).

Table 1. *The molars TCMP used in this study*

Pattern	Tooth	Gradation	Grades of expression		Reference method
			Range	Presence	
Cusp pattern	75 and 85 36 and 46 37 and 47	Y. Cusps 2 y 3 in contact +. Cusps 1, 2, 3 y 4 in contact X. Cusps 1 y 4 in contact	Y, +, X	Y	ASUDAS Turner II et al (1991)[10]
Deflecting wrinkle	75 and 85 36 and 46 37 and 47	0. Absent 1. Shallow constriction 2. Deep constriction 3. L-shaped	0-3	2-3	ASUDAS Turner II et al (1991)[10]

In this way, three anatomical variants of the cusp pattern expression have been described in the first deciduous lower molars and the first and second permanent lower molars: 1) when the mesiovestibular cusp contacts the distolingual cusp, so that the transverse mesiobuccal, distobuccal and lingual grooves form a Y; 2) when the mesiobuccal, distobuccal mesolingual and mandibular cusps contact in the central fossa, producing a pattern of transverse grooves in +, and 3) when the distobuccal cusp contacts the mesiolingual cusp through a pattern of transverse grooves in X. On the other hand, it should be noted that the lower molars may have 4 to 7 cusps, and therefore the cusp pattern can be Y4, Y5, Y6, Y7, +4, +5, 6, +7, X4, X5, X6 and X7. However, a better understanding of the phylogenetic development of the morphology of lower first molars has shown that the cusp pattern expression does not depend on the number of cusps, so both phenotypic expressions correspond to two independent dental morphological traits that are studied as a whole to identify differences among populations.[11, 12]

Deflecting wrinkle

The deflecting wrinkle was first identified by Weidenreich in 1937, in his studies of extinct hominids (*Sinanthropus pekinensis* and *Gigantopithecus blacki*); in modern humans, it was identified in deciduous dentition by von Koenigswald in 1950 and in permanent dentition by Suzuki and Sakai in 1956. Later, Hanihara included it between 1964 and 1970 as one of the morphological traits that define the Mongoloid dental complex. Finally, Seybert and Turner II included it in the ASUDAS system in 1975.[13-15]

This TCMP describes how the main mesiolingual cusp heads towards the central fossa of the second deciduous lower molar and the first and second permanent lower molars. Thus, the presence of this trait is identified when this slope is deviated (forming a deflection) in distal direction towards the distolingual cusp up to the cross lingual developmental groove[16] (Table 1).

MATERIALS AND METHODS

Descriptive observational study correlating the frequency and variability of cusp pattern and deflecting wrinkle in 480 plaster models of six ethnic groups from southwestern Colombia (Figure 1), corresponding to 100 Caucasoid mestizos from Cali (50 women and 50 men), 60 Afro-descendants from Cali (34 women and 26 men), 84 Afro-descendants from Puerto Tejada (42 women and 42 men), 116 Afro-descendants from Villa Rica (57 men and 59 women), 60 indigenous misak (37 women and 23 men) and 60 indigenous nasa (35 women and 25 men).

Figure 1. *Geographical distribution of the six ethnic groups taken into account in this study. 1) mixed Caucasoid from Cali (Valle del Cauca), 2) Afro-descendants from Cali (Valle del Cauca), 3) Afro-descendants from Puerto Tejada (Cauca), 4) Afro-descendent from Villa Rica (Cauca), 5) indigenous misak from Silvia (Cauca), and 6) indigenous nasa from Morales (Cauca).*

The plaster models used in this study are part of the collection of the Research Line in Dental Anthropology and Forensic Dentistry (Línea de Investigación en Antropología Dental y Odontología Forense) of Universidad del Valle School of Dentistry, which were obtained for research projects previously endorsed by the Universidad del Valle's Institutional Committee of Ethics in Human Studies, so that the sample complied with the assent and informed consent of participants, stating that the models could be used in future studies, in accordance with Resolution 008430 of the Ministry of Social Protection.[17]

The ASUDAS system for observation and analysis was used to observe the two TCMP's using a 10 X magnifier and a thin tip probe, starting at the second deciduous lower molars (75 and 85), the first

permanent lower molars (36 and 46) and the second permanent lower molars (37 and 47).[10] As the models were observed, information about the two TCMP's was recorded in an Excel® worksheet and was later processed in version 22.0 of the IBM SPSS® Statistics software, by means of descriptive statistic test for frequencies, univariate and bivariate analysis for sexual dimorphism (Mann-Whitney U), bilateralism (Wilcoxon) and correlation between traits (Spearman's correlation coefficient). A value of $p < 0.05$ was considered statistically significant.

RESULTS

The two TCMP's show diverse expressions in the six ethnic groups, which is possibly associated with the dental complex from which they have received influence (Table 2). The cusp pattern was characterized by a Y shape in the second deciduous lower molars of mestizos and Afro-descendants from Cali, as well as the two indigenous groups. This expression varied in the first permanent lower molar, where patterns + and X showed mid frequencies. In the case of permanent second lower molars, the most frequent pattern was +, and Y the less frequent. The deflecting wrinkle showed a more homogeneous behavior in the six ethnic groups, with significant presence in the second deciduous lower molars of mestizos from Cali and the indigenous nasa. The groups of mestizos from Cali, Afro-descendants from Villa Rica and indigenous misak had mid frequencies in the first permanent lower molars, as well as the second permanent lower molars of mestizos from Cali. None of the six ethnic groups showed sexual dimorphism and both TCMP's were bilaterally expressed (Tables 3 and 4). Similarly, it was evident that there is correlation between expression Y of the cusp pattern and grades 2 and 3 of the expression of the deflecting wrinkle (Figure 2). In this way, the configuration of the Y cusp pattern would be determined—bilaterally and with no sexual dimorphism—by the morphological conformation of the main groove of the mesiolingual cusp as a deflecting wrinkle, being moderate in the second deciduous lower molars, high in the permanent lower first molars, and low in the second permanent lower molars (Table 5).

Table 2. *Frequency and variability (%) of the two TCMP's taken into account in this study*

Cusp pattern									
Ethnic groups*	**Second deciduous lower molars (75 and 85)**			**First permanent lower molars (36 and 46)**			**Second permanent lower molars (37 and 47)**		
	Y	**+**	**X**	**Y**	**+**	**X**	**Y**	**+**	**X**
MC	81.0	17.0	2.0	40.0	59.0	1.0	16.0	84.0	0.0
AC	86.7	3.3	10.0	48.3	21.7	30.0	23.3	30.0	46.7
APT	42.2	20.7	37.1	47.4	36.2	16.4	42.3	55.2	2.6
AVR	25.0	28.4	46.6	2.6	47.4	50.0	7.8	84.5	7.8
IM	66.7	25.0	8.3	18.3	16.7	65.0	1.7	6.7	91.7
IN	63.3	23.3	13.3	35.0	13.3	51.7	28.3	68.3	3.3
Deflecting wrinkle									
Ethnic groups*	**Second deciduous lower molars (75 and 85)**			**First permanent lower molars (36 and 46)**			**Second permanent lower molars (37 and 47)**		
	0	**1**	**2,3**	**0**	**1**	**2,3**	**0**	**1**	**2,3**
MC	29.0	25.0	46.0	7.0	45.0	48.0	12.0	35.0	53.0
AC	20.0	78.3	1.7	23.4	45.0	31.6	33.4	43.3	23.3
APT	37.1	33.6	29.3	50.9	21.6	27.6	43.1	29.3	21.5
AVR	6.9	63.8	29.3	2.6	39.6	55.2	22.4	60.3	17.3
IM	25.0	40.0	35.0	18.3	26.7	55.0	58.3	36.7	5.0
IN	1.7	31.7	66.6	55.0	26.7	18.3	25.0	65.0	10.0

** MC = mixed Caucasoid from Cali; AC = Afro-descendants from Cali; APT = Afro-descendants from Puerto Tejada; AVR = Afro-descendants from Villa Rica; IM = Indigenous Misak from Silvia; IN = Indigenous Nasa from Morales.*

Table 3. *Bilateralism of the two TCMP's taken into account in this study*

Cusp pattern ($p < 0.05$)			
Ethnic groups*	**Second deciduous lower molars (75 and 85)**	**First permanent lower molars (36 and 46)**	**Second permanent lower molars (37 and 47)**
MC	0.061	0.228	0.071
AC	0.157	0.655	0.378
APT	0.474	0.254	0.808
AVR	0.908	0.617	0.285
IM	0.379	1.000	0.102
IN	0. 117	0.625	0.272
Deflecting wrinkle ($p < 0.05$)			
MC	0.475	0.271	0.260
AC	0.180	0.672	0.527
APT	0.617	0.449	0.069
AVR	0.655	0.520	0.467
IM	0.593	0.157	0.593
IN	0.202	0.572	0.157

** MC = mixed Caucasoid from Cali; AC = Afro-descendants from Cali; APT = Afro-descendants from Puerto Tejada; AVR = Afro-descendants from Villa Rica; IM = Indigenous Misak from Silvia; IN = Indigenous Nasa from Morales.*

Table 4. *Sexual dimorphism of the two TCMP's taken into account in this study*

Cusp pattern ($p < 0,05$)			
Ethnic groups*	**Second deciduous lower molars (75 and 85)**	**First permanent lower molars (36 and 46)**	**Second permanent lower molars (37 and 47)**
MC	0.731	0.061	0.030
AC	0.325	0.063	0.903
APT	0.922	0.225	0.199
AVR	0.532	0.992	0.080
IM	0.401	0.690	0.979
IN	0.347	0.349	0.499
Deflecting wrinkle ($p < 0.05$)			
MC	0.051	0.095	0.058
AC	0.080	0.569	0.513
APT	0.385	0.060	0.143
AVR	0.344	0.975	0.986
IM	0.707	0.918	0.554
IN	0.055	0.050	0.650

** MC = mixed Caucasoid from Cali; AC = Afro-descendants from Cali; APT = Afro-descendants from Puerto Tejada; AVR = Afro-descendants from Villa Rica; IM = Indigenous Misak from Silvia; IN = Indigenous Nasa from Morales.*

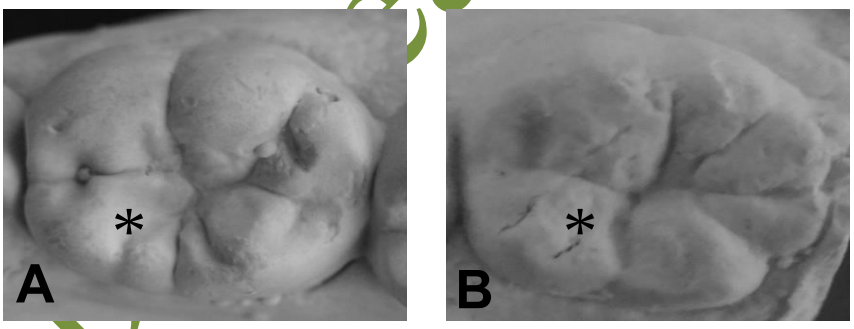

Figure 2. *Variations in cusp pattern and deflecting wrinkle (*) of the first permanent lower molar. A. dryopithecine Y cusp pattern and grade 3 deflecting wrinkle (constriction with L-shape); B. X cusp pattern and grade 1 deflecting wrinkle (shallow constriction).*

Table 5. *Spearman's rank correlation coefficient (Rho) between the expression of cusp pattern (CP) and deflecting wrinkle (DW)*

	CP Y 75 and 85	CP+ 75 and 85	CP X 75 and 85	CP Y 36 and 46	CP+ 36 and 46	CP X 36 and 46	CP Y 37 and 47	CP+ 37 and 47	CP X 37 and 47	DW 0 75 and 85	DW 1 75 and 85	DW 2,3 75 and 85	DW 0 36 and 46	DW 1 36 and 46	DW 2,3 36 and 46	DW 0 37 and 47	DW 1 37 and 47	DW 2,3 37 and 47
CP Y 75 and 85	1.000	–0.771	–0.829	0.600	–.0371	–0.429	–0.086	–0.486	0.143	0.143	0.029	0.580	0.086	0.618	–0.143	0.029	–0.143	0.429
CP + 75 and 85		1.000	0.486.	–0.943	0.257	0.771	–0.486	0.257	0.314	–0.371	0.086	–0.232	–0.314	–0.441	0.486	0.086	0.371	–0.771
CP X 75 and 85			1.000	–0.257	–0.029	0.257	0.314	0.371	0.029	–0.314	0.371	–0.348	0.086	–0.441	–0.029	0.029	0.314	–0.257
CP Y 36 and 46				1.000	–0.371	–0.657	0.657	–0.371	–0.257	0.429	0.029	–0.377	0.486	0.177	0.600	0.143	–0.429	0.657
CP + 36 and 46					1.000	–0.314	–0.257	0.657	–0.600	0.429	–0.486	0.232	–0.657	0.088	–0.486	–0.543	–0.429	0.314
CP X 36 and 46						1.000	–.314	–0.314	0.600	–0.429	0.143	0.290	0.200	–0.618	0.086	0.543	0.429	–1.000
CP Y 37 and 47							1.000	0.029	–0.543	0.143	–0.257	–0.029	0.771	–0.353	–0.886	0.029	–0.143	0.314
CP + 37 and 47								1.000	–.600	–0.257	–0.314	0.232	–0.429	0.265	0.200	–0.886	0.257	0.314
CP X 37 and 47									1.000	–0.371	0.771	–0.377	–0.086	0.000	0.371	0.600	0.371	–0.600
DW 0 75 and 85										1.000	–0.257	–0.203	–0.086	–0.177	0.029	0.257	–1.000	0.429
DW 1 75 and 85											1.000	–0.841	–0.200	0.177	0.371	0.371	0.257	–0.143
DW 2,3 75 and 85												1.000	0.203	–0.179	–0.261	–0.290	0.203	–0.290
DW 0 36 and 46													1.000	–0.530	–0.943	0.429	0.086	–0.200
DW 1 36 and 46														1.000	0.353	–0.618	0.177	0.618
DW 2,3 36 and 46															1.000	–0.143	–0.029	–0.086
DW 0 37 and 47																1.000	–0.257	–0.543
DW 1 37 and 47																	1.000	–0.429
DW 2,3 37 and 47																		1.000

Interpretation of the Spearman's Rho correlation: 0 = absent; 0-0.2 = very low; 0.2-0.4 = low; 0.4-0.6 = moderate; 0.6-0.8 = high; 0.8-1 = very high; 1 = perfect

DISCUSSION

The cusp pattern and the deflecting wrinkle, as stated in this study, have experienced great variability in their expression, associated with the behavior of global dental complexes since the second half of the last century. In this way, Hanihara included the Y cusp pattern and the deflecting wrinkle in the Mongoloid dental complex to group different populations of East Asia that had a complex dental morphology in common. Later, Turner II divided the Mongoloid dental complex into Northeastern Asian populations, or sinodonts, characterized by the Y cusp pattern and the intensification of expression of the deflecting wrinkle (grades 2-3), and Southeastern Asian populations, or sundadonts, who retained the ancestral Y condition but simplified the deflecting wrinkle (grade 1). Similarly,

Zoubov divided the global populations into the Eastern dental complex (the same Mongoloid dental complex of Hanihara) and the Western dental complex, consisting of northern Caucasoid and Negroid or southern Caucasoid populations, whose dental features include the high frequency of the + and X cusp pattern, and a low expression of deflecting wrinkle. Subsequently, Irish classified the southern Negroid populations of Africa (the same western dental complex of Zoubov) into the sub-Saharan dental complex and the North African dental complex, with significant expressions of pattern + and low expression of deflecting wrinkle.[18-22] Concerning the populations of the Americas, there is still some debate on the inclusion of the Paleo-Indian and contemporary peoples (indigenous groups, Afro-descendants and Caucasoid mestizos) in an americanoide dental complex, with morphological variations and frequencies very similar to the sinodont Mongoloid dental complex.[23]

In the case of the cusp pattern, Gregory described pattern Y with the presence of five cusps, a combination that is recognized as the classic or dryopithecine pattern of lower permanent molars.[8] Thus, a series of phylogenetic variations derived from this more primitive cusp pattern, including a first stage corresponding to the Y5 dryopithecine pattern as such, a second stage Y4 which reduces the number of cusps to four, a third stage + 5 or cross-shaped stage that changes the expression of the pattern, and a much more variable fourth stage including patterns + and X. In this way, it has been determined that expression Y is considered present, while patterns + and X are considered reductions.[9, 24] Studies in modern human populations have shown that one characteristic of the ethnic groups of Mongoloid and Negroid origins is that the first permanent lower molars have retained the ancestral condition Y, while the groups of Caucasoid origin have more frequent expressions + and X. In the case of the second permanent lower molars, the Negroid and Mongoloid show the same trend, but the number of cusps reduces from five to four with respect to the first molar.[25-27]

In this study, the permanent first lower molars maintained the same trend in the group of Afro-descendants from Cali, while the other five ethnic groups showed greater variability, as patterns + and X had mid frequencies, much more variable than the group of indigenous misak. In the case of the Caucasoid mestizos from Cali, there is a significant frequency of pattern +, agreeing with the literature reports. Regarding the cusp pattern of permanent second lower molars, the behavior was similar to what has been reported, with patterns + and Y being the most frequent. Finally, the second deciduous lower molars presented significant frequencies of pattern Y in the two groups from Cali and the two indigenous groups.

On the other hand, since it was first described in the first hominids from the Miocene, the deflecting wrinkle has been a TCMP frequently used to differentiate the Mongoloid populations from the Negroid and Caucasoid peoples, with a higher expression (grades 2-3) in the first permanent lower molars, and lower expression (grades 1-2) in the second permanent lower molars. Also, the higher frequencies of deflecting wrinkle have been observed in sinodont populations.[16]

In this study, the expression of this TCMP showed low frequency in the second deciduous lower molars (except in indigenous nasa) and mid frequencies in the first permanent lower molars (in Afro-descendants from Villa Rica and indigenous misak) and in the second permanent lower molar (mixed Caucasoid). Thus, the behavior of these two TCMP´s was associated with miscegenation of the contemporary Colombian population as a result of various ethnohistorical processes that have been traced back to the initial peopling of the Americas by groups derived from the sinodonts (Mongoloid dental complex) that formed the Paleo-Indian characterized by Y cusp pattern and grade 3 deflecting wrinkle; the arrival of different Northern Caucasoid human groups from Western Europe (Western dental complex) who populated the American territory during the discovery, conquest, and colony, which were characterized by an X cusp pattern and deflecting wrinkle in grades 0 and 1; the arrival of Negroid people groups (southern Caucasoid of the Western dental complex) brought into slavery, whose lower molars showed cusp pattern + and X, as well as low frequencies of deflecting wrinkle; and the numerous and constant microevolutionary processes (migrations, displacements, contacts, and isolations) that have occurred due to different social, religious, political, economic and demographic phenomena that have occurred in the territory, and that finally have influenced the establishment of the multi-ethnic, multicultural, and polygenic nature of the Colombian population, represented in the average tri-ethnic genetic composition of Colombians from the 62% Caucasoid, 26% Mongoloid and 12% Negroid genes.[28, 29]

In the particular case of Southwestern Colombia, all the described processes occurred more intensely than in other regions of the country—hence this region is considered an “ethnographic melting pot”—, so the study of morphological variations of contemporary mestizo Caucasoid, Afro-descendant and indigenous groups has shown that the phenotypic expressions of the TCMP’s go hand in hand with the historical miscegenation.[30]

Between the 17th and 19th centuries, the demographic development (geographic and ethnic distribution) of the territory between south of the Department of Valle del Cauca and north of the Department of

Cauca arose from the haciendas as a socio-economic model represented in the cultivation of land, mining, and livestock estates; and from there, several municipalities in the South of the Department of Valle del Cauca (Southeast of Cali and Jamundi) and North of the Department of Cauca (Robles, Puerto Tejada, Villa Rica and Santander de Quilichao), among others, arose from the settlement of freedmen, maroons and slaves of African descent in the territories of three large estates of field. With the abolition of slavery since 1852, the big landowners developed the *terraje* system, in which free people of African descent were allowed to settle on marginal lands of the estates and grow their own crops, in exchange for work. Given this new mechanism of disguised slavery, many black families preferred to occupy idle lands along the Cauca River, where they founded settlements.

At the beginning of the 20th century, with the emergence of sugar mills and the industrialization of plantations, the descendants of African slaves who failed to keep any plot of land entered the proletariat which was responsible for cutting the sugar cane, worked in other types of crops (cocoa, coffee, banana, tobacco), or emigrated to the city of Cali, where they occupied wasteland. Later, in the second half of the 20th century, there was an important demographic concentration of Afro-descendants in what is today known as the Aguablanca District, due to the migratory flows from the Pacific coast (caused by the tsunami that hit the Pacific coast), to the numerous migration waves mestizo peasants from the coffee belt (and on a lesser extent indigenous nasa, yanacona, and misak from the departments of Cauca, Huila and Nariño due to the public order situation of the region), and the job possibilities that still offer the sugar cane plantations.[31, 32] This is why the mestizos and Afro-descendants from the city of Cali taken into account in this study, inhabiting the Southeast area of the town, have retained the Y cusp pattern in the deciduous molars and have expressed patterns + and X in permanent molars, as well as mid frequencies of grades 1 and 2 of the deflecting wrinkle, as expressions that relate them to the sundadont Mongoloid complex of Hanihara, the Caucasoid dental complex of Turner II, the Western dental complex of Zoubov, the sub-Saharan dental complex of Irish and the Saharan Africa dental complex of Edgar.

In the case of indigenous groups, the nasa occupy the Musse Ukwe reservation of the municipality of Morales, and historically they have been exposed to a greater contact with settlers and mestizo peasants, hence the mean expression of both TCMP's suggest the ancestral influence of the Mongoloid sinodont dental complex and the modern miscegenation with groups of the Caucasoid dental complex. Otherwise has occurred with the nasa who occupy the territory of the Guambía reservation within the urban area of

the municipality of Silvia, where they have remained relatively isolated from other populations, hence the expressions of the Y cusp pattern in deciduous and permanent molars (although they showed mid frequencies of the + pattern) and grades 2 and 3 of the deflecting wrinkle, approaching them to the Mongoloid sinodont dental complex. Finally, the Afro-descendent groups from Villa Rica and Puerto Tejada are characterized by mid frequencies of the Y cusp pattern, mainly in the deciduous molars, and significant frequencies of +, in addition to a low expression of the deflecting wrinkle (grades 1-2), suggesting the maintenance of the dental morphology of the Caucasoid dental complex and influences of the Mongoloid sinodont dental complex, due to contacts with indigenous groups.

Configuration of the tribosphenic quadritubercular molar

Human molar teeth have five main cusps with their respective grooves and enamel bridges connecting them in a transversal direction, as well as the fosses and the transverse and longitudinal sulci which separate them—in addition to the variable presence of tubercles or paramolar cusps—.[33] During tooth morphogenesis, these cusps arise from a platform or dental girdle from growth centers which represent the cuspid vertices and whose biological proliferative and secretory activity extends over the girdle according to the position, shape and height of each cusp, connecting them together through the grooves and resulting in the formation of the pattern of cusps and sulci of deciduous and permanent posterior teeth.[34-36]

The occlusal surface of lower molars is then formed by three cusps (mesiobuccal, distobuccal and distal) with low and rounded corners —arranged towards the buccal surface—, separated from two cusps (mesiolingual and distolingual) with high and sharp corners —arranged toward the lingual surface— by a sulcus of central longitudinal development which runs from the mesial fossa to the distal fossa. Also, the sulcus of mesiobuccal transverse development separates the mesiobuccal and distobuccal cusps, the transverse development distobuccal sulcus separates the distobuccal and distal cusps, and the cross-lingual development sulcus separates the mesiolingual and distolingual cusps.[37, 38] All these transverse sulci converge in the central fossa, which sets up a system of fissures that can change in shape depending on the way the cusps grooves approach each other, which is called pattern of intercusp contact or simply cusp pattern.[9] The slope of the mesolingual cusp is the deflecting wrinkle while approaching the central fossa of the occlusal surface until it comes in contact with the slope of the distobuccal cusp, which is the ancient expression of the Y cusp pattern.

This study showed that the Y cusp pattern is formed when the deflecting wrinkle is expressed in grades 2 and 3, as was moderately seen in the second deciduous lower molars, highly on the first permanent lower molars, and low in the second permanent lower molars according to the Spearman's rank correlation coefficient.

These findings support the morphogenetic field theory proposed by Butler in 1939, which claims that each type of teeth (incisors, canines, premolars and molars) has a gradient of variation in which there is a tooth whose morphogenetic process is well preserved and very unlikely to be affected by the environment. In the case of molars, the molar morphogenetic field is represented by the second deciduous molar.[39] In this study, the second deciduous lower molars retained the ancestral condition of Y cusp pattern and the significant expression of the deflecting wrinkle since the six ethnic groups are influenced by the Mongoloid sinodont dental complex; however, the historical miscegenation that has taken place in the region has caused variations in the expression of the two TCMP's in permanent lower molars (much more in the second), since environmental factors can affect the configuration of the occlusal surface, which has finally set the trend towards simplification of the structures of contemporary American populations.[40] Similar results were found by Edgar and Lease,[41] Smith et al,[42] and Ocampo et al.[43]

CONCLUSIONS

Due to the miscegenation of the population in Southwestern Colombia (South of Valle del Cauca and North of Department of Cauca) from mixed Caucasoid, indigenous and Afro-descendant ethnic groups, the frequencies of cusp pattern and deflecting wrinkle show a wide variability according to the ASUDAS criteria; therefore, the expression of both TCMP's helped differentiate the mixed Caucasoid and African-descendant groups (with a tendency towards the Caucasoid dental complex) from indigenous groups (with a tendency towards the Mongoloid dental complex). We can then conclude that, in the six ethnic groups taken into account in this study, the cusp pattern configuration may vary according to the degree of expression of the deflecting wrinkle, in such a way that the expression of the Y cusp pattern prevails when the deflecting wrinkle is expressed in grades 2 and 3—a special trait of contemporary Colombian populations who have received influences from Mongoloid sinodont groups as evidenced by the Spearman's rank correlation coefficient.

Finally, in the dental context, it is essential to recognize the way the occlusal surface—from the expression, variability, bilateral symmetry, and sexual dimorphism in morphological traits—of the lower molars is set up during procedures of morphofunctional restoration of the tooth structure altered through operation and oral rehabilitation. Hence the importance for dentists to address morphology from different areas of knowledge, including dental anthropology.

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CONFLICTS OF INTEREST

The authors state that there was no conflict of interest that might have put the validity of the findings at risk.

CORRESPONDING AUTHOR

Freddy Moreno Gómez
Pontificia Universidad Javeriana (Cali). Facultad de Ciencias de la Salud.
(+572) 321 8200 Extensión: 8927
fmorenog@javerianacali.edu.co
Calle 18 N.° 118-250 Edificio Raúl Posada, Segundo Piso
Cali-Colombia

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