Dental Anthropology Research Conducted at the School of Dentistry of the Universidad del Valle (Cali, Colombia) between 2002 and 2021: A Literature Review

Freddy Moreno[1,2]* and Natalia Coriat[1]

[1] Pontificia Universidad Javeriana Cali, Colombia

[2] School of Dentistry of the Universidad del Valle, Colombia

Keywords: dental morphology, dental complexes, ethnic pattern, biological distances, literature review

ABSTRACT In the last 20 years, the Dental Anthropology and Forensic Dentistry Research Group at the Universidad del Valle (Cali, Colombia) has integrated knowledge from anthropology, dentistry, biology, paleontology and paleopathology to characterize the dental morphology of living populations in southwestern Colombia. This has been done by studying the frequency and variability of dental morphological features in populations with different ancestries, including Euro-descendants, Afro-descendants and Native Americans. The group has employed strategies such as formative research and the creation of cooperative research networks to publish and disseminate their findings on dental morphology mainly within the Colombian dental clinical context. However, these studies have been limited in their impact on the international anthropological academic community due to a lack of publication in English and refusals from some specialized journals to publish research on contemporary Colombian populations. To address this issue, this article aims to provide a literature review of the research on dental anthropology carried out at the School of Dentistry of the Universidad del Valle (Cali, Colombia) between 2002 and 2021. Despite the high amount of available information, the results of this scientific research have been difficult to make visible, search, access, and recover.

At the School of Dentistry of Universidad del Valle (Cali, Colombia), dental anthropology is considered an interdisciplinary area of knowledge that integrates anthropology, dentistry, biology, paleontology, and paleopathology. The objective is to study all the information provided by human dentition, including anatomical, evolutionary, pathological, cultural and therapeutic variations. This is done by taking into consideration the living conditions, culture, nutrition and adaptation processes of present and past human populations, through the morphology, measurements, diseases, and modifications of the teeth (Hillson, 1996; Scott & Turner, 1997, 1998).

In particular, a group of researchers from the aforementioned university has focused their interest on dental metric and nonmetric variations. Their approach has allowed for the documentation, analysis, explanation, and understanding of a range of dental phenotypes that can provide insight into the biological relationships among human populations. These dental variations also serve as intergroup markers that facilitate comparative analysis to clarify the history, origin, formation, contact, isolation, and displacement of past and present human groups (Alt et al., 1998; Rodríguez, 2003, 2004).

In Colombia, dental anthropology began relatively late compared to other Latin American countries, such as Mexico and Peru. Some anthropological and paleontological studies on living populations and archaeological samples had been carried out earlier by researchers such as Paul Rivet, Gonzalo Correal, Miguel Méndez, Martin Nweeia, Edward Harris, Héctor Polanco, and Benjamin Hera-

*Correspondence to:
Freddy Moreno
Faculty of Health Sciences at the Pontificia Universidad Javeriana Cali (Colombia)
School of Dentistry of the Universidad del Valle (Colombia)
Email: fmorenog@javerianacali.edu.co

zo, among others. However, the field gained more attention in 1989 with the publication of the "Cuaderno de Antropología No. 19" of the Universidad Nacional (Bogotá, Colombia) entitled "Introducción a la antropología dental" by the anthropologist José Vicente Rodríguez. This work compiled all available information on the metric and morphological variations of teeth in human populations, drawing mainly from previous research by the Institute of Ethnology and Anthropology of the Russian Academy of Science (Moscow, Russia) and studies on the origin and diversity of Americans carried out by Arizona State University.

Since then, dental anthropology research in Colombia has focused on forensic sciences, specifically within the context of forensic anthropology and the study of oral morbidity in pre-Hispanic communities. In 1997, Alexander Zoubov gave a lecture on "La antropología dental y la práctica forense" at the symposium "De lo prehispánico a lo forense: avances de la antropología biológica en Colombia," which shifted the research focus towards forensic applications. Notable contributions to this field include the work carried out by the Expedición Humana of the Pontificia Universidad Javeriana (Bogotá, Colombia), the studies conducted by the Laboratorio de Antropología Física of the Universidad Nacional by José Vicente Rodríguez, the work of the groups Antropacífico and Antropos under the supervision of anthropologists Carlos David Rodríguez and Miguel Eduardo Delgado Burbano at the Departamento de Antropología of the Universidad del Cauca (Popayán, Colombia), and the studies conducted by the Julio César Cubillos Museum of the Universidad del Valle under the historian Carlos Armando Rodríguez (Rodríguez, 2003; Moreno and Moreno, 2007).

At the end of the 20th century, research groups focused on dental anthropology were formed in the Schools of Anthropology of the Universidad Nacional and the Universidad del Cauca. However, it wasn't until 2004 that a study group from a School of Dentistry, led the Dental Anthropology and Forensic Dentistry Research Group, as was the case with the Oral and Maxillofacial Surgery Research Group of the School of Dentistry of the Universidad del Valle, whose researchers joined forces to disseminate knowledge from other disciplines that have studied teeth and to apply this information in the dental, anthropological, and forensic contexts. Although the study group was inactivated by 2014, the research has continued independently through the work of dentists Sandra Moreno and Freddy Moreno (Moreno-Gómez et al., 2019).

To keep research in dental anthropology active, two fundamental strategies were implemented. The first strategy was to establish scientific cooperation alliances with the "Laboratorio de Antropología Física" of the Universidad Nacional, with the "Instituto Nacional de Medicina Legal y Ciencias Forenses de Colombia." and with the "Laboratorio de Identificación de la Fiscalía General de la Nación de Colombia." The second strategy was to use formative research so that dentistry students from different universities in Colombia could develop their theses on topics related to dental anthropology, mainly dental measurements and dental morphology. Thus, during the last 20 years, a series of studies have been carried out in contemporary populations of southwestern Colombia to generate new knowledge on the frequency and variability of non-metric dental traits from research studies, to update the current understanding through literature reviews, to describe the unusual presence of some dental morphological characteristics through case reports, and to encourage critical reading through systematic analysis of the literature (Moreno-Gómez et al., 2019).

The aim of this study is to perform a literature review of the research in dental anthropology conducted at the School of Dentistry of the Universidad del Valle (Cali, Colombia). Due to the lack of available scientific information and the difficulties in searching, accessing, and retrieving scientific research results, it is not possible to objectively quantify the scientific knowledge generated. The literature review is a type of research synthesis that aims to map the literature on a particular topic or research area and identify key concepts and types of evidence generated in the research practice, produced by individuals (researchers), groups (research groups, centers, and institutes), and educational institutions (departments, faculties, and universities) (Daudt et al., 2013).

Materials and Methods

This study reviewed publications on dental anthropology conducted at the School of Dentistry of the Universidad del Valle (Cali, Colombia) with the participation of dentistry students from different universities. Their theses were advised by researchers affiliated with the Dental Anthropology and Forensic Dentistry Research Group through formative research processes. All populations stud-

ied gave their consent to participate and received feedback from the researchers, allowing them to recognize their ethnic origin from the historical processes of colonization in Colombia over the last 500 years. Specifically, these results have been used in the ethnographic processes of identity construction for community councils of Afro-descendant populations and governorates of indigenous communities.

The categories used to classify articles and perform the comprehensive review were: article name, year of publication, study type, population studied, sample, journal of publication, country of the journal, language of publication, publisher, thematic context, and number of citations (Table 1).

Results

Between 2002 and 2021, 44 articles were identified that met the inclusion criteria. Therefore, the Dental Anthropology and Forensic Dentistry Research Group published an average of 2.09 articles per year.

Of these articles, 29 (65.9%) were published in dental journals, including 13 (33.3%) in the *Revista Estomatología*, which allowed for the scientific dissemination of the School of Dentistry of the Universidad del Valle. The remaining articles were published in biomedical journals (10.3%), anthropological journals (13.6%), morphological science journals (5.1%), and forensic journals (5.1%).

Twenty-eight of the journals in which articles were published were edited by public universities (63.6%); five by private universities (11.3%); four by scientific societies (10.3%) and four by private publishers (10.3%).

Thirty-six articles were published in Spanish (81.8%), five in English (11.3%), and three in both languages (7.69%).

All 44 articles implemented the keyword dental anthropology (100%), 38 implemented dental morphology (86.3%), four implemented dental measurements (9.09%), 13 implemented forensic anthropology (30.2%), 12 implemented dental identification (27.2%), and three implemented radiology (7.7%).

Twelve of the journals in which the articles were published are indexed in MedLine (30.8%), 17 in DOAJ (38.6%), 23 in Latindex (52.2%), 11 in SciELO (28.2%), and 31 in national (Colombia) and regional (Latin America) indexes (79.5%). Thirty-four of these articles have been cited from Google Scholar (87.1%), six articles from Publons (2.34%), and five from Scopus (1.95%).

The articles were derived from 23 undergraduate degree works, one undergraduate degree work in pediatric dentistry, and one master's degree work in criminalistics. Fourteen articles were derived from research processes carried out by professors as part of their scientific activities. The 39 articles included a total of 90 dentistry students (2.6 students per study) and six graduate students. Likewise, 78 participations of professors were observed with an average of 2.2 professors per article.

According to the methodological design of the study, 30 articles corresponded to descriptive observational studies (68.1%), 11 articles to literature reviews (25%), and four articles to case reports (9.09%).

Regarding the thematic area, 36 articles corresponded to dental morphology (81.8%), four articles to dental measurements (9.09%), three articles to dental eruption (7.7%), one article to dental morphology and dimensions (2.6%), and one article to general dental anthropology (2.6%). Likewise, and according to the observational method of the sample, 28 articles used plaster models obtained from dental impressions taken of the individuals that made up the sample (63.6%), three used panoramic radiographs (7.7%), five were mainly case reports that used direct observation of the patients (12.8%), and eight did not conduct any type of observational study because they were literature reviews with a purely theoretical approach (18.1%).

According to the type of dentition, permanent dentition was studied in 25 articles (56.8%), deciduous and permanent dentition in 16 articles (41.0%), deciduous dentition in two articles (4.5%), and no type of dentition was specified in two articles (5.1%). The most frequently observed teeth were incisors in 22 articles (50%), canines in 10 articles (22.7%), premolars in 19 articles (43.1%), and molars in 31 articles (79.5%).

The dental morphological features most frequently observed in the studies were winging in seven articles (17.9%), crowding in six articles (15.4%), shovel-shaped incisors in 13 articles (30.2%), Carabelli's trait in 20 articles (45.4%), hypocone reduction in eight articles (20.5%), protostylid in 20 articles (45.4%), deflecting wrinkle in 13 articles (29.5%), cuspid pattern in 15 articles (34.09%), number of cusps in 10 articles (25.6%), cusp 6 in 12 articles (30.8%), and cusp 7 in 12 articles (30.8%). Similarly, other morphological features were observed in canines, premolars, and molars in 17 articles (38.6%).

Regarding the methods of observation of dental morphological features, ASUDAS (Arizona State University Dental Anthropology System) was used for permanent dentition in 25 articles (56.8%), ASUDAS, Hanihara (1961), Grine (1986), and Sciul-

Table 1. Scientific articles organized by year of publication

Article	Year	Type of study	Population studied	Sample	Journal	Country	Language	Publisher	Thematic context	Google citations	Publons Citations	Scopus citations
Moreno & Moreno	2002	Literature review	None	0	Revista Estomatología	Colombia	Spanish	Universidad publica	Forensic	21	0	0
Moreno et al.	2004	Descriptive observational	Mixed group	100 individuals (50 females and 50 males)	Colombia Médica	Colombia	Spanish	Universidad publica	Anthropological	55	0	7
Moreno & Moreno	2005	Descriptive observational	Mixed group and indigenous	100 individuals (50 females and 50 males)	International Journal of Dental Anthropology	Colombia	English	Editorial privada	Anthropological	34	0	0
Rodríguez & Moreno	2006	Case Report	Mixed group	1 individual (1 female)	Dental Anthropology	United States	English	Sociedad científica	Odontological and Anthropological	23	0	0
Aguirre et al.	2006	Descriptive observational	Mixed group and indigenous	100 individuals (50 females and 50 males)	Dental Anthropology	United States	English	Sociedad científica	Anthropological	53	0	0
Rocha et al.	2007	Descriptive observational	Indigenous	84 individuals (42 females and 42 males)	Colombia Médica	Colombia	Spanish	Universidad publica	Anthropological	36	2	3
Aguirre et al.	2007	Descriptive observational	Mixed group	100 individuals (50 females and 50 males)	International Journal of Dental Anthropology	Colombia	English	Editorial privada	Anthropological	4	0	0
Moreno & Moreno	2007	Literature review	None	0	Revista Estomatología	Colombia	Spanish	Universidad publica	Odontological and Anthropological	12	0	0
Aguirre et al.	2007	Descriptive observational	Mixed group and indigenous	100 individuals (50 females and 50 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Anthropological	5	0	0
Hernández et al.	2007	Case Report	Indigenous	1 individual (1 male)	Revista Facultad de Odontología Universidad de Antioquia	Colombia	Spanish	Universidad publica	Odontological and Anthropological	2	0	0
Aragón et al.	2008	Descriptive observational	Indigenous	96 individuals (48 females and 48 males)	Revista Odontológica Mexicana	Mexico	Spanish	Universidad publica	Anthropological and Forensic	29	0	0
Girón et al.	2009	Descriptive observational	Mixed group, Afro-Colombians and indigenous	110 individuals (46 females and 66 males)	International Journal of Morphology	Chile	Spanish	Universidad privada	Odontological, Anthropological and Forensic	27	0	4
Ocampo et al.	2009	Descriptive observational	Mixed group, Afro-Colombians and indigenous	285 individuals (97 females and 104 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Anthropological	14	0	0
Soto et al.	2010	Literature review	None	0	Acta Odontológica Venezolana	Venezuela	Spanish	Universidad publica	Odontological and Anthropological	0	0	0
Corral et al.	2010	Descriptive observational	Mixed group	196 individuals (109 females and 87 males)	Colombia Médica	Colombia	Spanish	Universidad publica	Odontological and Forensic	38	14	15

Table 1. Scientific articles organized by year of publication, cont'd

Article	Year	Type of study	Population studied	Sample	Journal	Country	Language	Publisher	Thematic context	Google citations	Publons Citations	Scopus citations
Moreno & Moreno	2010	Case Report	Mixed group	1 individual (1 male)	Revista Estomatología	Colombia	Spanish	Universidad publica	Odontological and Anthropological	9	0	0
Hernández et al.	2010	Literature review	Indigenous	5 individuals (5 males)	Revista Facultad de Odontología Universidad de Antioquia	Colombia	Spanish	Universidad publica	Odontological and Anthropological	22	3	0
Goyes et al.	2011	Descriptive observational	Mixed group and indigenous	122 individuals (59 females and 63 males)	Revista Colombiana de Investigación en Odontología	Colombia	Spanish	Sociedad científica	Anthropological	8	0	0
Castillo et al.	2011	Descriptive observational	Mixed group, Afro-Colombians and indigenous	66 individuals (27 females and 39 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Odontological, Anthropological and Forensic	9	0	0
Acosta et al.	2011	Descriptive observational	Mixed group, Afro-Colombians and indigenous	48 individuals (24 females and 24 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Odontological, Anthropological and Forensic	12	0	0
Marcovich et al.	2012	Descriptive observational	Afro-Colombians	116 individuals (59 females and 57 males)	Revista Facultad de Odontología Universidad de Antioquia	Colombia	Spanish and English	Universidad publica	Anthropological	26	3	0
Padilla et al.	2013	Descriptive observational	Mixed group, Afro-Colombians and indigenous	126 individuals	International Journal of Morphology	Chile	Spanish	Universidad publica	Odontological, Anthropological and Forensic	9	1	0
Díaz et al.	2014	Descriptive observational	Afro-Colombians and indigenous	60 individuals (35 females and 25 males)	Colombia Médica	Colombia	Spanish	Universidad publica	Anthropological	40	6	7
García et al.	2015	Descriptive observational	Indigenous	60 individuals (37 females and 23 males)	Revista Colombiana de Investigación en Odontología	Colombia	Spanish	Sociedad científica	Anthropological	1	0	0
García et al.	2015	Descriptive observational	Mixed group and indigenous	60 individuals (34 females and 26 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Anthropological	10	0	0
Hernández et al.	2015	Literature review	Mixed group and indigenous	0	Revista Facultad de Odontología Universidad de Antioquia	Colombia	Spanish and English	Universidad publica	Odontological, Anthropological and Forensic	6	0	0
Pérez et al.	2016	Descriptive observational	Mixed group and Afro-Colombians	195 individuals (101 females and 94 males)	Cuadernos de Medicina Forense	Spain	Spanish	Editorial privada	Odontological and Forensic	4	0	0

Table 1. Scientific articles organized by year of publication, cont,'d

Article	Year	Type of study	Population studied	Sample	Journal	Country	Language	Publisher	Thematic context	Google citations	Publons Citations	Scopus citations
Moreno et al.	2016	Case Report	Mixed group, Afro-Colombians and indigenous	1 individuals (1 male)	Journal of Forensic Dental Sciences	India	Spanish	Editorial privada	Odontological, Anthropological and Forensic	3	0	0
Moreno & Moreno	2016	Descriptive observational	Mixed group, Afro-Colombians and indigenous	380 individuals (206 females and 174 males)	Revista Científica Sociedad de Ortodoncia	Colombia	Spanish	Sociedad científica	Odontological and Anthropological	0	0	0
Moreno & Moreno	2016	Literature review	None	0	Revista Estomatología	Colombia	Spanish	Universidad publica	Odontological and Anthropological	0	0	0
Moreno & Moreno	2016	Literature review	Mixed group, Afro-Colombians and indigenous	0	Revista Estomatología	Colombia	Spanish	Universidad publica	Anthropological and Forensic	2	0	0
Zúñiga et al.	2016	Descriptive observational	Mixed group, Afro-Colombians and indigenous	24 embera (13 females and 11 males), 27 afrodescendientes (16 females and 11 males) and 32 Caucasoid mixed etiology (18 female and 14 males)	Revista Nacional de Odontología	Colombia	Spanish	Universidad privada	Anthropological	5	0	0
Carreño et al.	2017	Descriptive observational	Mixed group	355 individuals (181 females and 174 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Odontological and Forensic	4	0	0
Pérez et al.	2017	Descriptive observational	Indigenous	101 individuals (59 females and 42 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Anthropological	3	0	0
Asprilla et al.	2017	Descriptive observational	Mixed group, Afro-Colombians and indigenous	100 individuals (50 females and 50 males)	Revista Estomatología	Colombia	Spanish	Universidad publica	Anthropological	1	0	0
Moreno & Moreno	2017	Descriptive observational	Mixed group, Afro-Colombians and indigenous	30 individuals (15 females and 15 males)	Revista Nacional de Odontología	Colombia	Spanish	Universidad privada	Odontological and Anthropological	2	0	0
Moreno & Moreno	2017	Literature review	None	0	Revista Odontológica Mexicana	Mexico	Spanish	Universidad publica	Odontological and Anthropological	0	0	0

Table 1. Scientific articles organized by year of publication, cont'd

Article	Year	Type of study	Population studied	Sample	Journal	Country	Language	Publisher	Thematic context	Google citations	Publons Citations	Scopus citations
Parra et al.	2018	Descriptive observational	Mixed group, Afro-Colombians and indige-nous	480 individuals (257 females and 223 males)	Revista Facultad de Odontología Universidad de Antioquia	Colombia	Spanish and English	Universida d publica	Anthropological and Forensic	0	0	0
García et al.	2018	Descriptive observational	Mixed group, Afro-Colombians and indige-nous	60 individuals (37 females and 23 males)	Revista Nacional de Odontología	Colombia	Spanish	Universida d privada	Anthropological	0	0	0
Marin et al.	2020	Systematic literature review and Case Report	Mixed group	1 individual male	Dental Anthropology	United States	English	Sociedad científica	Anthropological	0	0	0
Amado et al.	2019	Descriptive observational	Mixed group, Afro-Colombians and indige-nous	613 individuals (344 females and 269 males)	Journal Odontológico Colegial	Colombia	Spanish	Universida d privada	Odontological	0	0	0
García et al.	2020	Descriptive observational	Afro-Colombians	60 individuals (37 females and 23 males)	Journal Odontológico Colegial	Colombia	Spanish	Universida d privada	Odontological	0	0	0
Moreno & Moreno	2021	Literature review	None	0	Revista Facultad de Odontología Universidad de Antioquia	Colombia	Spanish and English	Universida d publica	Anthropological and Forensic	0	0	0
Hurtado et al.	2021	Descriptive observational	Indigenous	30 individuals (16 females and 14 males)	Jangwa Pana	Colombia	Spanish	Universida d pública	Anthropological	0	0	0

li (1998) were used for permanent and deciduous dentition in 11 articles (25%), and ASUDAS, Hillson (1996), van Reenen et al. (1998), and Higa et al. (2003) were used for premolars in three articles (6.8%). One article used Powell and Humphreys (1984) for dental arch form (2.6%), and three articles used the methods of Massler, Moorrees et al. (1963), Demirjian et al., (1973), and Smith (2005) to estimate eruption pattern (7.7%). Four articles did not employ any observational method as they were literature reviews (10.3%). Finally, one article used manual intercuspal dimensions to determine the area of the occlusal polygon (2.2%). Only one article considered dental metric features, meso-distal and buccolingual dimensions, specifically for premolars) (2.6%), using the method of Moorrees et al. (1963).

The samples included in the studies were defined as mixed populations in 28 articles (63.6%), Afro-Colombians in 19 articles (43.1%), and indigenous people in 29 articles (65.9%) (Figure 1). It is important to mention, according to the discussion by Pilloud et al. (2021), that in all the studies carried out, the traditional anthropological nomenclature has prevailed, classifying the studied populations according to their Caucasoid, Negroid, and Mongoloid origin. However, because biological anthropologists are now avoiding these terms, this article uses the terms "Asian," "African," and "European" under the category of continental descent.

The results of the studies were directed towards dental contexts in 21 articles (47.7%), with 16 of them oriented towards the study of dental anthropology with dental clinical correlation, anthropological in 38 articles (86.3%), and forensic in 14 articles (31.8%).

Figure 1. Location of contemporary Colombian human populations that have been studied by the Research Group of Dental Anthropology and Forensic Odontology of the Universidad del Valle. A. Choco region (groups of Afro-descendants, Native Americans –embera– and mixed groups); B. Valle del Cauca region (mixed groups and Afro -descendants); C. Cauca region (groups of Afro-descendants –Puerto Tejada and Villarrica–, Native Americans –Nasa and Misak– and Caucasoid mixed origin); D. Amazon region (groups of indigenous –Ticuna, Huitoto and Cocama–).

Discussion

The results obtained will be discussed under four thematic categories: bibliometrics, formative research, methodology implemented, and obtained results. It should be noted that the discussion is not exhaustive due to space limitations and will focus mainly on dental morphology since it has the greatest impact and is the most studied by the Dental Anthropology and Forensic Dentistry Research Group.

The review of the categories considered in this study helped to determine that the Dental Anthropology and Forensic Dentistry Research Group has been active since 2002. Two research professors initiated the group's activities within a university that lacks a School of Anthropology and a School of Dentistry that does not offer a specialization in forensic dentistry. Their aim was to investigate dental anthropology to broaden and deepen knowledge among dentistry students on dental morphology and its application in other contexts, such as anthropology and forensic dentistry. It is worth highlighting the editorial effort of the Colombian anthropologist Carlos David Rodríguez, who edited and published the International Journal of Dental Anthropology to promote the dissemination of Colombian research on topics related to bioarchaeology, paleontology, anthropology, dentistry, and forensic dentistry with an international perspective (Rodríguez-Flórez, 2005). This is similar to Debbie Guatelli-Steinberg's (2018) description of the Dental Anthropology Newsletter (today *Dental Anthropology*) and research in dental anthropology in the context of North American biological anthropology.

López-Lázaro et al. (2016) conducted a systematic review of the literature on non-metric dental traits in current South American populations. They found that remarkable scientific production has

been generated around the study of non-metric dental traits in the last few decades. This study aimed to define the geographical patterns of contemporary South American human groups and to propose the possibility of using the frequency of differential expression traits in the forensic context. The authors identified the *Revista Estomatología* (Colombia), *Dental Anthropology* (United States), and *American Journal of Biological Anthropology* (United States) as the journals with the most publications (four each), followed by the *International Journal of Morphology* (Chile) and *Colombia Médica* (Colombia) with three each. The *HOMO Journal of Comparative Human Biology* (Germany), *Journal of Dental Research* (United States), *Human Biology* (United States), *Revista de la Facultad de Odontología de la Universidad de Antioquía* (Colombia), and *Universitas Odontologica* (Colombia) had two publications each. Out of the 18 journals identified, six were from Colombia, four from the United States, two from Germany, and one each from Argentina, Canada, Chile, Ireland, Mexico, and Uruguay. It is noteworthy that seven journals are dedicated to general dentistry, three to general anthropology, two to biology, two to dental anthropology, two to forensic sciences (one of them to forensic dentistry), one to morphology, and one to medicine. However, most articles have been published in dental journals, specifically in the *Revista Estomatología*, which is edited by the same academic unit to which the authors belong. This is mainly due to the difficulty that still exists in the Colombian environment to publish in English (Moreno et al., 2012). Despite this, some results were disseminated in anthropological, morphological, and forensic journals, adjusting the focus of the objectives and methodological designs of the studies to include specialized journals whose publication language is English. This includes *Dental Anthropology*, edited by the Dental Anthropology Association in the United States, since the scientific genre's standard norm is writing in English, and the international community has limited access to articles written in Spanish (Ferguson et al., 2011).

Although the information obtained from the research has been relevant and had some local and regional impact, the results have not gained much visibility in the international community. Publishing in English in journals indexed in international directories and using different strategic thematic descriptors, such as dental anthropology, dental morphology, and non-metric dental traits, has contributed to an increase in the number of citations (as measured by the h index of Google Scholar). The articles published in journals indexed in MedLine and DOAJ, which are considered of high impact as they are included in Publons and Scopus, have achieved the highest number of citations due to their greater visibility (Madsen, 2019). This finding is consistent with the results of our analysis, which show that articles published in *Dental Anthropology*, *Colombia Médica*, and *International Journal of Morphology* have received the highest number of citations among articles in English published in international journals.

Formative research

The Dental Anthropology and Forensic Dentistry Research Group, formerly included in the Oral and Maxillofacial Surgery Research Group of the School of Dentistry at Universidad del Valle, has been operating independently since the group was inactivated in 2014. Two research professors have continued the group's work and have found an opportunity to make an academic and scientific impact on the dental field through formative research. The group's focus is mainly on dental morphology and dimensions from the perspective of dental anthropology.

A bibliometric analysis of research conducted at the School of Dentistry at Universidad del Valle revealed that topics such as forensic dentistry and dental anthropology, which are not very common in the national dental academic context, have gained relevance in undergraduate dentistry. Approximately 100 dentistry students from different universities in southwestern Colombia, including Universidad del Valle, Universidad Santiago de Cali, Institución Universitaria Colegios de Colombia, and Universidad Antonio Nariño, have developed 23 undergraduate degree projects resulting in 39 publications (Pizarro et al., 2018).

In this regard, López-Lázaro et al. (2016) analyzed the impact of the Dental Anthropology and Forensic Dentistry Research Group. Since 2000, the number of publications on dental morphology in different South American countries has been increasing, thanks to the impact of the Dental Anthropology Association and the publication of *Dental Anthropology*, as well as the systematization of the observation, registration, and analysis of dental morphological features through ASUDAS.

In the specific case of Colombia, the work of Rodríguez since 1989 and the development of research groups in different Colombian schools of anthropology since 2000 marked the beginning of the systematic study of dental anthropology. However, the vast majority of publications have been developed in dental schools, all of them being the product of formative research processes conducted

by odontologist Freddy Moreno, in an attempt to raise awareness of the importance of dental anthropology from an anthropological point of view. The expression and variability of dental morphological features can predispose or favor the development of a pathological process, and a correct diagnosis based on the knowledge of the behavior of the feature as an etiological factor is fundamental in dental clinical practice based on preventive, diagnostic, and therapeutic evidence (Moreno and Moreno, 2007).

All this confirms the important presence of publications in journals with a dental profile. However, it is essential to strengthen interdisciplinary work between anthropologists and dentists to solve potentially conflicting methodological competencies when studying dental morphology in individuals in a clinical context (López-Lázaro et al., 2016).

Lastly, it is worth highlighting the support provided by professors with diverse specialties who acted as thematic advisors and methodological tutors within the Research Group of Dental Anthropology and Forensic Dentistry. These professors integrated collaborative work in formative research, thus creating a community of interest and a culture of sustainable research over time. This has resulted in the creation of an important network of academic and scientific cooperation, which is composed of dentists, anthropologists, epidemiologists, and statisticians. In this regard, López-Lázaro et al. (2016) stated that the authors of publications on dental morphology in South America mainly have an academic profile in dentistry (57 from Colombia, 10 from Brazil, eight from Chile, six from Argentina, three from Paraguay and Uruguay, two from Canada and South Africa, and one from Venezuela). This is followed by eight geneticists (five of them from Chile), three anthropologists (all from Colombia), three statisticians, two speech therapists (Chile), one archaeologist (United States), and one epidemiologist (Colombia).

Methodology implemented in the studies on dental morphology

The impetus created by anthropologist José Vicente Rodriguez to the Research Group of Dental Anthropology at the Universidad del Valle since 2000 was not only based on the theoretical deepening of the study of dental morphology in the anthropological and forensic context but also on the methodological foundation of observing and recording the expression and variability of dental morphological traits. The ASUDAS method, proposed by Christy G. Turner, Christian R. Nichol, and G. Richard Scott, and complemented by different authors during the development of new morphological traits, such as van Reenen et al. (1998) and Higa et al. (2003) or for its application in the deciduous dentition such as Hanihara (1961), Grine (1986), and Sciulli (1998), has been used as an instrument of analysis. However, Fonseca et al. (2016) stated that although ASUDAS has globalized the study of dental morphology, its use still does not transcend the boundaries of anthropology, making the system practically unknown in the dental context.

López-Lázaro et al. (2016) also indicated that not all studies carried out by dentists used ASUDAS as a methodological framework, which could eventually make it difficult to compare results globally. According to the same authors, the low usage of ASUDAS could be due to a lack of knowledge of its existence or to the difficulty of use. As of 2006, only 242 sets of plaques had been distributed in 36 countries (more than half distributed in the United States). In South America, the plates were only distributed in physical form in Argentina, Chile, and Brazil. Hence, their use has only been possible through internships and collaborations between researchers.

On the other hand, there have been reports on morphological features that are considered "unusual" in the dental clinical context (López-Lázaro et al., 2016). Since the morphogenetic development of these features is unknown, they are often misdiagnosed as sites prone to the accumulation of bacterial plaque and the development of dental caries or periodontal disease (Moreno and Moreno, 2007). Therefore, beyond anthropological interest and forensic utility, the majority of the studies developed by the Research Group of Dental Anthropology and Forensic Dentistry have had the purpose of expanding the knowledge of dentists about dental morphology through descriptive observational designs, literature reviews, and case reports. For example, there have been efforts to expand the information on different ontological aspects of the dental cingulum, a morphological structure misunderstood by many dentists, and its implications in periodontal disease (Moreno and Moreno, 2016). There have also been studies to divulge the expression and variability of the protostylid and its controversial point expression in the fossa (P point) during caries diagnosis, as well as the expression of a fossa of Carabelli's trait (Hernández et al., 2014; Moreno & Moreno, 2017).

López-Lázaro et al. (2016) discussed that 19 studies from the Research Group of Dental Anthropology and Forensic Dentistry led by dentist Fred-

dy Moreno made specific mention of the potential use of dental morphological features as forensic identification tools. However, the limitations of using these features for forensic identification have been described by Edgar (2009). Despite this potential forensic application, the studies on dental anthropology conducted by the Research Group have primarily had a clinical orientation (López-Lázaro et al., 2016).

Obtained results

According to Scott and Turner (1997), just over 100 morphological traits have been identified and described in the crowns and roots of teeth, of which no more than 30 have been widely used for the study of populations due to their high frequency. The majority of observational studies carried out by the Research Group in Dental Anthropology and Forensic Odontology, which described the dental morphology of different populations of southwestern Colombia, used ten of these traits.

Regarding winging and crowding position traits, Rodriguez (2003) stated that despite the lack of knowledge of their global variation, these traits have been used to discriminate the Sinodonts from the Sundadonts within Asian populations, which has given them an important value in intragroup comparisons.

Moreno and Moreno (2016) found that, after studying five southwestern Colombian populations, the frequency of winging was low, and its variability was characterized by expressions in grade 2 unilateral in Afro-descendants from Cali and Villa Rica, and in grade 1 bilateral in Afro-descendants from Puerto Tejada, Indigenous Nasa, and Misak. The frequency of crowding in Afro-descendants from Cali and Villa Rica, and in Indigenous Misak from Silvia was observed in a greater expression of grade 1, and in Afro-descendants from Puerto Tejada and the Nasa de Morales indigenous people, the highest expression was grade 2.

Another morphological feature that can be observed in anterior teeth is the shovel-shaped incisors, which Hanihara (1992) used, along with four other traits, to develop the Asian dental complex due to its high frequency in North Asian populations. This trait has been useful in differentiating these populations from European and African populations. After Turner (1984) studies, it was demonstrated that Sinodont groups, which originated in Asia, crossed the Bering Strait and began to populate the American continent, so all pre-Hispanic and contemporary American Indians have conserved the ancestral Asian condition of shovel-shaped incisors, with expressions of over 80%. Rodriguez (2003) has used this trait to discriminate between European populations and Asian populations, including Amerindians. Different studies on Colombian indigenous populations have identified high frequencies of the shovel-shaped incisor trait in groups that have remained relatively isolated, while the decrease in their expression (grades 1 to 3) could be associated with mixed origin with European and Afro-descendant mixed origin groups (Rodríguez, 2003; Aragón et al., 2008; Díaz et al., 2014).

One of the most interesting traits to study in contemporary Colombian populations is Carabelli's trait, which is considered a European trait with great discriminating power between mixed, Afro-Colombian, and indigenous Colombian groups. However, through different studies, it has been possible to understand that the dichotomous expression (absence/presence) of the ASUDAS reference plaque should not be associated with ethnically mixed origin (Aragón et al., 2008; Díaz et al., 2014, Zúñiga et al., 2016), due to the fact that indigenous Colombian populations have been characterized by presenting fossa expressions in intermediate degrees, which are considered present in the gradation, so they have been recognized as a characteristic pattern of all Amerindians (Rodríguez, 2003). In a study that grouped different contemporary populations of southwestern Colombia, it was found that mixed groups presented fossa expressions, Y depressions, and small cusps. Afro-descendant groups had the expression of medium and large cusps with free vertex. Indigenous groups had pit expressions. Nevertheless, the authors observed that the ethnic groups mentioned were not grouped according to the three established dental complexes because Carabelli's trait did not constitute itself as an ethnic discriminator. This conclusion was associated with the mixed origin of the populations of southwestern Colombia given the tendency of the mixed population of Cali, the Afro-descendants of Puerto Tejada and the Nasa indigenous people to group with Asian populations (pit shape expressions), while the Afro -descendants of Villarica, Guapi, and Tumaco did so with European populations (cuspid expression) (Moreno and Moreno, 2017).

The behavior of Carabelli's trait contrasts with the hypocone reduction because the worldwide expression of this trait varies from 13% in European to 95% in Asian populations, according to Rodriguez (2003). In Colombian populations, regardless of the ethnic component, the tendency has

been to maintain the size of the distolingual cusp from the first upper molar towards the second, without significantly impacting the dichotomous expression of the ASUDAS, except for some reports in mestizo populations, where reduction has been observed in grades 3 and 4 (Pérez et al., 2017).

Another dental morphological trait that deserves attention in Colombian populations is the protostylid. This trait is defined as an indigenous trait with low frequencies in European, African, and Asian populations. The high expression of the P-point is particular to American populations (Zoubov, 1998). In their study, Hernández et al. (2014) concluded that the frequency of the protostylid of the first lower permanent molars allowed the grouping of the categories mentioned, according to the three established world dental complexes. In this way, the processes of mixed origin influenced its expression by decreasing the groove expression, weak or small cusp and free cusp tip in the indigenous groups and increasing the pit expression or P-point in the Euro-descendant and Afro-descendant mixed populations. However, the protostylid was not, by itself, a morphological feature that discriminated the population groups of southwestern Colombia.

Regarding the cuspid pattern and the deflecting wrinkle, two traits considered to belong to the Asian populations, Parra et al. (2017) correlated their expression in different contemporary populations. They concluded that, due to the mixed origin of the population of southwestern Colombia (south of Valle del Cauca and north of the department of Cauca) from Euro-descendant mixed populations, indigenous and Afro-descendant ethnic groups, the expressions of both traits showed great variability. This made it possible to differentiate the groups of Euro-descendant mixed populations and Afro-descendants (with a tendency towards the European populations) from the indigenous groups (with a tendency towards the Asian populations). This was represented in the configuration of deciduous lower first molars with significant frequencies of cuspid pattern (Y expression) and deflecting wrinkle (grades 2 and 3), permanent lower first molars with relative frequencies of cuspid pattern (Y and + expressions) and deflecting wrinkle (grades 1 and 2), and permanent lower second molars with significant frequencies of cuspid pattern (+ and X expressions) and deflecting wrinkle (grades 1 and 2). The classic Y groove pattern (Dryopithecus Pattern) predominates in Asian populations, while the X and + configurations considered reductions predominate in African and European populations. Therefore, the variability in the configuration of the way the cusps contact each other and the number of cusps tends to conserve the classic pattern and reduce to the other patterns as mixed origin with European and African populations becomes evident.

Finally, the expression of cusps 6 and 7 has been considered ethnically distinctive. Hanihara (1992) identified cusp 6 as being more prevalent in Asian populations, while Turner (1984) demonstrated high frequencies of this cusp in groups of Paleo-Indians and pre-Hispanic Amerindians due to its origin. On the other hand, cusp 7 has been observed with greater frequency in Afro-descendant populations. In contemporary Colombian populations, the expression of both cusps has varied depending on the Asian, European, and African ethnic components and the extent of historically mixed populations associated with the geographic distribution of a specific population (Rodríguez, 2003).

Dental complexes

Since the 1991 political constitution, Colombia has identified itself as a multicultural and multiethnic country, acknowledging the presence of five ethnic groups: Native Americans, Afro-Colombians (differentiated into negros, raizales and palenqueros according to the 2015 National Population and Housing Census), romani populations (Rom or Gypsy group that is part of the ethnic and cultural diversity of Colombia), and mixed populations without ethnic recognition (called mestizos) dispersed throughout various geographical regions shaped by ethnohistorical processes during the conquest, colony, struggles for independence, formation of the republic, and the current armed conflict.

Dental morphology studies have provided valuable contributions to the ability to compare past and present populations based on the frequency (expression) and variability (gradation) of dental morphological traits. Various statistical methods, such as similarity or dissimilarity matrices, have been employed to determine the proximity or distance between populations. These matrices can be plotted using dendrograms, which show the biological distances between human groups. In the anthropological context, Smith's Mean Measure of Divergence (MMD) has been predominantly used, which is based on the degree of dissimilarity between samples. However, in the Colombian dental context, the squared Euclidean distance has been commonly used to obtain a distance matrix for hierarchical cluster analysis. Both statistical methods rely on the frequencies of dental morphological

traits that can be grouped into clusters to represent the way in which human populations are associated, either by similarity or dissimilarity, regarding their geographic distribution. These studies have made it possible to ethnically classify human beings into complex populations based on dental morphology. Due to the complexity of the concept of race, the Research Group of Dental Anthropology and Forensic Dentistry has adjusted the use of the notions of ethnicity and ancestry to avoid biological determinism and incorporate concepts from social anthropology, sociology, and historiography. This approach has enabled the group to focus the research discussion on genotype, phenotype, dental complexes, and geographic distribution. The homogenizing narrative of mixed origin has been challenged, and the notion of interculturality is being explored to integrate the ethnocultural diversity of the entire Colombian population.

The term "dental complex" or "population dental complex" refers to the way in which past and present human populations can be grouped based on the frequency and variability of dental morphological traits. This allows for grouping populations based on their Asian, European, and African origins, as well as the way in which they behave intragroup and intergroup (Turner, 1984, 1990; Hanihara, 1992; Irish, 1997; Zoubov, 1998; Edgar, 2007). In Colombia, the study of dental morphology and its association with the revised dental complexes has been challenging due to the complex ethnohistoric processes that have occurred in the region. Rodríguez (2003) proposed that past indigenous populations were characterized by high frequencies of winging, crowding, hypocone reduction, deflecting wrinkle, and the P-point of the protostylid, which placed them closer to the Paleoindians derived from the Sinodonts. However, for contemporary indigenous populations, the study of dental morphology and its association with the described dental complexes has been complicated due to 500 years of mixed origin resulting from the arrival of western European groups, represented by the Spanish conquistadors, and African groups represented by African slaves who populated the American territory in three historical processes recognized as the discovery, conquest, and colony.

This process of mixed origin was particularly pronounced in the southwestern region of Colombia, especially in the south of the department of Valle del Cauca and the north of the departamento del Cauca. This justifies why the largest number of studies on contemporary populations described as mixed populations, Afro-descendants, and indigenous Colombians have been conducted in that region by the Research Group of Dental Anthropology and Forensic Odontology at the Universidad del Valle. The results of these studies concluded that the frequency of morphological traits is a consequence of mixed origin and the dominance of certain phenotypic expressions of morphological traits. Thus, mixed populations were characterized by the simplification of dental morphology, with low frequencies of Carabelli's trait, which was ambiguously expressed in its fossa forms (Asiatic characteristic) and medium-sized cusps (European characteristic) the reduction of the hypocone, which is typical of Western European populations, and the high frequency of the protostylid P-point, a trait exclusive to American Indian populations (Moreno et al., 2004; Pérez et al., 2017).

Contemporary indigenous populations have preserved the Asian populations with significant frequencies of winging, crowding, shovel-shaped incisors, the deflecting wrinkle, the protostylid P-point and the cuspid Y groove pattern; however, they have incorporated morphological features of the European populations such as Carabelli's trait (fossa expressions and small cusps) and the cuspid X and + pattern (Diaz et al., 2014) and Afro-descendant populations have been characterized by presenting high frequencies of medium-sized Carabelli trait, cuspid + pattern, X pattern and high frequency of cusp 7, suggesting a notable influence of the European populations (Marcovich et al., 2012; Rocha et al., 2007; García et al., 2015).

Delgado-Burbano (2007) indicated that Afro-Colombians derive from Africans who arrived in the American continent as slaves from West Africa, Central West Africa (sub-Saharan Africa), Southeast Africa, and the North, all of them classified in the African-western dental complex. The dental morphological traits that have been most widely used to estimate the ethnic pattern in the Colombian anthropological and forensic contexts are the Carabelli's trait, protostylid, cusp 6, and cusp 7, which have high taxonomic value and intragroup discriminating power. The statistical information accumulated from different world populations has allowed grouping the populations through the frequency and variability of these traits, represented in distance matrices and plotted through dendrograms (Rodriguez, 2003). The dendrogram generated by Pérez et al. (2017), which grouped the largest number of Colombian populations studied based on these morphological traits and according to the influence of the three world dental complexes, is included in this article (Figure 2).

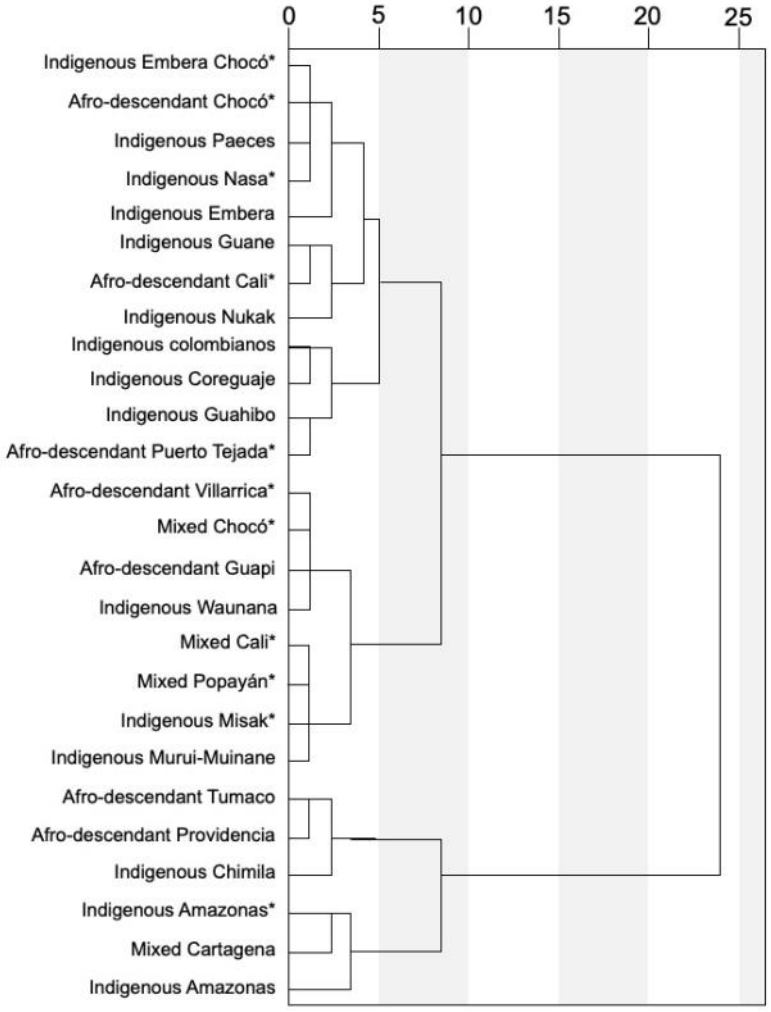

Figure 2. Dendrogram showing the biological distance between different Colombian populations and Colombian populations of mixed groups, Native Americans, and Afro-descendants, based on the frequency and variability of the Carabelli trait, protostylid, cusp 6 and cusp 7. *Contemporary Colombian human populations studied by the Research Group of Dental Anthropology and Forensic Odontology of the Universidad del Valle.

The dendrogram shows that mixed groups, Afro-descendants, and indigenous people are distributed in clusters according to the dichotomous expression and variability of the four traits included in the analysis. The expressions of Carabelli's trait in fossa (grade 1 to grade 3 ASUDAS), protostylid in grooves and small cusps (grade 2 and 3 ASUDAS), cusp 6 in small cusps (grade 1 and 2 ASUDAS), and the absence of cusp 7, grouped populations with a tendency to the Asian dental complex, as in the case of groups of Emberá, Paeces, Nasa, Guane, and Nukak Indigenous groups distributed in specific geographic regions where contact with other groups of mixed groups and Afro-descendants has been reduced.

In contrast, indigenous groups such as Coreguaje, Guahibo, Waunana, Misak, and Murui-Muinane, who share territory with mixed groups from Cali and Popayán, as well as Afro-descendant groups from Puerto Tejada, Villarica, and Guapi, presented a higher frequency of Carabelli's trait in small cusp expression (grade 4 ASUDAS). On the other hand, these same mixed and Afro-descendant groups were characterized by cuspid expressions of the Carabelli trait and the expression of cusp 7 (grades 2 and 3 ASUDAS), even though they exhibited pit expressions of Carabelli's trait and the P-point of the protostylid associated with the intense process of mixed origin that has historically occurred in the southwest of Colombia

with Nasa and Misak indigenous groups. It is worth noting that the P-point expression can be found in the same tooth as other grades of the protostylid; however, in contemporary populations of southwestern Colombia (mixed groups, Afro-descendant, and indigenous groups), the prevalence of the cuspid expression of this trait is practically absent, according to the dichotomous expression defined by ASUDAS, while the prevalence of the P-point is between 80% and 100% (Hernández et al., 2014).

Interest in the forensic context

During the process of forensic identification and medical-legal documentation, whether dealing with living or deceased individuals, it is crucial to establish their identity. The search for identity is conducted through the general biographical reconstruction, also known as the biological profile. This includes the estimation of age, sex, ethnic pattern, and stature through the application of validated bioanthropological methods (Rodriguez et al., 1995). Teeth provide significant information for estimating age (chronology of dental development and eruption, as well as dental wear), sex (dental measurements), and population pattern (dental morphology), and in many cases, are the only element capable of providing biological and cultural information on an individual or human population (Rodríguez, 2003; Rodríguez-Flórez, 2003, 2005).

Most population studies on dental morphological traits have demonstrated their great value in classifying human groups according to their ethnic origin and geographic distribution, and the absence of sexual dimorphism and bilateral asymmetry in the expression of dental morphological traits. Additionally, particular expressions of tubercular features, such as paramolar cusps (Carabelli's trait, parastyle, and protostylid), can individualize a human being (Rodriguez, 2003, 2004, 2011).

In Colombia, the Instituto Nacional de Medicina Legal y Ciencias Forenses reported in 1993 that 72% of all cases in which bone and dental remains were analyzed with bioanthropological techniques and methods corresponded to mixed origin populations with Caucasoid characteristics, while 28%, 7%, and 1% corresponded to mixed origin populations with Asian, Indigenous, and Afro-descendant characteristics, respectively (Rodriguez, 2004). Despite ongoing controversy over the use of dental morphological traits and their limitations, their observation and recording can be considered as an attempt to test their validity as a method of ancestry estimation in a forensic context (Edgar, 2005; 2013). Therefore, it is necessary for research areas to keep constant work and to carry out studies on statistical prediction models to test whether dental Fmorphological traits are valid as a method of ancestry estimation in a forensic context, or if they can be used as a complementary method to others (López-Lázaro et al., 2016).

Based on the information presented in this article, studies on morphological characterization carried out in contemporary populations of southwestern Colombia have shown that the frequency and variability of dental morphological traits differ among mixed populations, Afro-Colombian populations, and contemporary indigenous populations (Moreno-Gómez, 2019):

Mixed populations are characterized by low expressions of shovel-shaped incisors (grades 2 and 3 ASUDAS), fossa and cuspid expressions of Carabelli's trait (grades 3 and 4 ASUDAS), hypocone reduction (grades 2 and 3 ASUDAS), absence of deflecting wrinkle, variations of the cuspid pattern between Y and + with five cusps; absence of protostylid combined with mean P-point expressions, and absence of cusps 6 and 7.

Afro-Colombian populations are characterized by absence of shovel-shaped incisors, cuspid expressions of Carabelli's trait (grades 4 and 5 ASUDAS), hypocone reduction (grades 2 and 3 ASUDAS), absence of deflecting wrinkle, cuspid x or + pattern with five or six cusps, absence of protostylid combined with middle expressions of P-point, and relative expressions of cusp 7 (grades 2 and 3 ASUDAS).

Contemporary Indigenous populations are characterized by high frequencies of shovel-shaped incisors (grades 3 to 6 ASUDAS), reduced Carabelli's trait (grades 2 and 3 ASUDAS), absence of hypocone reduction, deflecting wrinkle (grade 3 ASUDAS), cuspid Y groove pattern with five and six cusps, groove expressions and small protostylid cusps (grades 2 and 3 ASUDAS) combined with P-point, and relative expressions of cusp 6 (grades 2 and 3 ASUDAS).

However, according to the territory occupied by the human groups and the historical processes of mixed origin, the behavior (frequency and variability) of some of the traits may change.

Conclusions

This literature review has enabled the continuous work of the Dental Anthropology and Forensic Dentistry Research Group at the School of Dentis-

try of the Universidad del Valle (Cali, Colombia) to be followed up. For nearly 20 years, this group has characterized the dental morphology of southwestern Colombia through the study of the frequency and variability of dental morphological traits in different populations of mixed groups, Afrodescendants, and Native Americans. However, it is necessary to expand the research on other topics of dental anthropology that have been barely addressed by the Dental Anthropology and Forensic Dentistry Research Group, such as the study of dental measurements, dental eruption patterns, and dental pathologies applied to anthropological and forensic contexts.

The strategies employed by the Dental Anthropology and Forensic Dentistry Research Group, including formative research and the formation of cooperative research networks, have contributed to the publication and dissemination of the results of studies on dental morphology, mainly in the Colombian dental clinical context. The thematic direction of the studies and the journals in which the articles were published demonstrated the impact on the knowledge that dentists have about dental morphology from an anthropological point of view, and how this knowledge can be applied to their clinical interest as etiological factors associated with the accumulation of bacterial plaque and the subsequent development of caries and periodontal disease. However, the publication of research in international anthropological contexts is limited by the lack of publications in English and resistance from some specialized journals to research in contemporary Colombian populations. Nevertheless, it is important to understand that, given the current conditions for research and publication in dental anthropology, researchers from universities in the United States, Great Britain, and Australia have been able to create a broader vision of the study of dental morphology by comparing and contrasting anthropological knowledge from Latin American countries, such as Colombia, based on information published in English and high-impact specialized journals.

From an anthropological perspective, one of the most significant accomplishments of the Research Group has been the systematic study of contemporary Colombian populations of European, Native American, and African origin, historically settled in southwestern Colombia. This has enabled the construction of a population dendrogram based on the frequency and variability of four non-metric dental traits (Carabelli's trait, protostylid, cusp 6, and cusp 7), which have been observed, registered, and analyzed using the ASUDAS methodology. These findings are comparable to other population studies that have used this methodology worldwide. Additionally, it has been identified that the expression of dental morphological traits is bilaterally symmetrical and does not present sexual dimorphism.

Considering that forensic dental identification processes rely on comparative and reconstructive methods, it is crucial to urge clinical odontologists to include in clinical records the description of the presence and variation of morphological characteristics with marked expressions in the four classes of teeth and in both dentitions. This would allow dental experts and forensic anthropologists to use dental morphology in estimating the ethnic pattern during the biographical reconstruction of an individual or their human remains. Hence, dental morphological features can become reliable markers for comparative use in antemortem-postmortem comparisons when carrying out the biological profile.

In conclusion, the efforts of the Dental Anthropology and Forensic Dentistry Research Group are currently focused on finding ways to make the international dental anthropological and dentistry community aware of the research on Colombian dental anthropology. The researchers, comprising anthropologists and odontologists, have appropriated various theories and methods to create their own discourse on the behavior of dental morphological traits. This article precisely presents an account of this "discurso propio del otro (nosotros)" and is presented in tension with the anxiety produced by encountering the "discurso universal del hegemónico (ustedes)" with whom we share the ambition of generating applicable knowledge in the anthropological, dentistry and forensic contexts. The aim is to make the knowledge generated during these 20 years of work visible and to believe that it is possible to think outside the hegemonic discourses.

Acknowledgements

The authors express their gratitude to dentist María del Mar Díaz Posso for her contribution to the tabulation of the scientific papers considered in this publication.

References

Acosta, D., Porras, A., & Moreno, F. (2011). Relación entre forma del contorno facial, arcos dentarios e incisivos centrales superiores en estudiantes universitarios de la ciudad de Cali. *Revista Estomatología*, 19(1), 14-19.

Aguirre, L., Castillo, D., Solarte, D., & Moreno, F.

(2006). Frequency and variability of five non-metric dental crown traits in the primary and permanent dentitions of a racially mixed population from Cali, Colombia. *Dental Anthropology*, 19(2), 39-47.

Aguirre, L., Castillo, D., Solarte, D., Moyano, M., & Moreno, F. (2007). Analysis of three non-metric dental traits in a living population from Colombia. *International Journal of Dental Anthropology*, 10, 24-35.

Aguirre, L., Castillo, D., Solarte, D., Moyano, M., & Moreno, F. (2007). Morfología dental en dentición mixta: Correlación de tres rasgos morfológicos en dientes temporales y permanentes de escolares de Cali, Colombia. *Revista Estomatología*, 15(2), 10-18.

Alt, K.W., Rosing, F.W., & Teschler-Nicola, M. (1998). *Dental anthropology: fundamentals, limits and prospects*. New York: Springer-Verlag.

Amado-Calvo, C.C., Jaramillo, A., & Moreno, F.A. (2019). Polígono oclusal y cúspide de Carabelli en segundos molares deciduos y primeros molares permanentes del maxila. *Journal Odontológico Colegial*, 12(23), 8-22.

Aragón, N., Bastidas, C., Bedón, L.K., Duque, P., Sánchez, M., Rivera, S., Triana, F., Bedoya, N., & Moreno, F. (2008). Rasgos morfológicos dentales coronales en dentición temporal y permanente: distancia biológica entre tres grupos indígenas del Amazonas colombiano. *Revista Odontológica Mexicana*, 12(1), 13-28.

Asprilla, P., Franco, K., Morales, J., & Moreno, F. (2017). Caracterización morfológica de la dentición permanente de un grupo de afrodescendientes de Istmina (Chocó, Colombia). *Revista Estomatología*, 25(2), 17-24.

Carreño, B., de la Cruz, S., Gómez, M., Piedrahita, A., Sepúlveda, W., Moreno, F., & Hernández, J.A. (2017). Cronología de la erupción dentaria en un grupo de mestizos caucasoides de Cali (Colombia). *Revista Estomatología*, 25(1), 16-22.

Castillo, L., Castro, A.M., Lerma, C., & Moreno, F. (2011). Diámetros meso-distales y vestíbulo-linguales dentales de un grupo de mestizos de Cali, Colombia. *Revista Estomatología*, 19(2), 16-22.

Corral, C., García, F., García, J., León, P., Herrera, A., Martínez, C., & Moreno, F. (2010). Edad cronológica versus edad dental en niños de 5 a 19 años: Un estudio comparativo con implicaciones forenses. *Colombia Médica*, 41(3), 215-23.

Daudt, H.M., van Mossel, C., Scott, S.J. (2013). Enhancing the scoping study methodology: a large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology*, 13, 48.

Delgado-Burbano, M.E. (2007). Population affinities of African Colombians to Sub-Saharan Africans based on dental morphology. *Homo*, 58(4), 329-56.

Demirjian, A., Goldstein, H., & Tanner, J.M. (1973). A new system of dental age assessment. *Annals of Human Biology*, 45, 211-27.

Díaz, E., García, L., Hernández, M., Palacio, L., Ruiz, D., Velandia, N., Villavicencio, J., & Moreno, F. (2014). Frecuencia y variabilidad de la morfología dental en dentición temporal y permanente de un grupo de indígenas Nasa del municipio de Morales (Cauca, Colombia). *Colombia Médica*, 45(1), 15-24.

Edgar, H.J.H. (2005). Prediction of race using characteristics of dental morphology. *Journal of Forensic Sciences*, 50(2), 269-73.

Edgar, H.J.H. (2007). Microevolution of African American dental morphology. *American Journal of Physical Anthropology*, 132(4), 535-44.

Edgar, H.J.H. (2009). Testing the utility of dental morphological traits commonly used in the forensic identification of ancestry. In T. Koppe, G. Meyer G., & K.W. Alt (Eds.), *Comparative dental morphology* (pp. 49-54). Basel: Karger.

Edgar, H.J.H. (2013). Estimation of ancestry using dental morphological characteristics. *Journal of Forensic Sciences*, 58(1), 3-8.

Ferguson, G.C., Pérez-LLantada, C., & Plo, R. (2011). English as an international language of scientific publication: A study of attitudes. *World Englishes*, 30, 41-59.

Fonseca, G.M., Aramburú, G., Rodríguez, I., Bollini, G.A., Atencio, J.P., Berta, M.J., López-Lázaro, S., Cantín, M., & Lissera, R.G. (2016). Development of research on morphological variation of historical South American populations based on non-metric dental traits. *International Journal of Morphology*, 34(1), 116-126.

García, A., Gustín, F., Quiñonez, C., Sacanamboy, L., Torres, M.H., Triana, L., Valencia, D., Rojas, E., Gómez, J., Díaz, J., Sánchez, P., & Moreno, F. (2015). Caracterización morfológica de incisivos y molares de un grupo de afrodescendientes de Cali, Valle del Cauca (Colombia). *Revista Estomatología*, 23(2), 17-29.

García, A., Gustín, F., Quiñonez, C., Sacanamboy, L., Torres, M.H., Triana, L., Valencia, D., Rojas, E., Gómez, J., Díaz, J., Sánchez, P., & Moreno, F. (2015). Frecuencia y variabilidad de 12 rasgos morfológicos dentales coronales en premolares de un grupo de indígenas Misak de Silvia, Cauca (Colombia). *Revista Nacional de*

Odontología, (17), 77-89.

García, A., Gustín, F., Quiñonez, C., Sacanamboy, L., Torres, M.H., Triana, L., Valencia, D., Rojas, E., Gómez, J., Díaz, J., Sánchez, P., & Moreno, F. (2018). Superficie lingual de los caninos deciduos en un grupo de indígenas misak (Cauca, Colombia): una mirada desde la antropología dental. *Revista Nacional de Odontología*, 14(27), 1-12.

García, A., Gustín, F., Quiñonez, C., Sacanamboy, L., Torres, M.H., Triana, L., Valencia, D., Rojas, E., Gómez, J., & Moreno, F. (2020). Cresta accesoria mesial y distal de premolares superiores en un grupo de afrodescendientes de Cali (Colombia). *Journal Odontológico Colegial*, 13 (25), 35-47.

Girón, G., Gómez, P., Morales, L., León, M., & Moreno, F. (2009). Rasgos morfológicos y métricos dentales coronales de premolares superiores e inferiores en escolares de tres instituciones educativas de Cali, Colombia. *International Journal of Morphology*, 27(3), 913-925.

González, E.M. (2006). La investigación formativa como una posibilidad para articular las funciones universitarias de la investigación, la extensión y la docencia. *Revista Educación y Pedagogía*, 18(46), 101-9.

Goyes, J., Guerrero, L., Narváez ,N., & Moreno, F. (2011). Rasgos morfológicos dentales coronarios de caninos temporales y permanentes en un grupo de mestizos de Cali, Colombia. *Revista Colombiana de Investigación en Odontología*, 2(5), 1 -13.

Grine, F.E. (1986). *Anthropological Aspects of the Deciduous Teeth of African Blacks*. In Singer L Lundy JK (Editors). Variation Culture and Evolution in African Populations. Johanessburg: Witwatersrand University Press.

Guatelli-Steinberg, D. (2018). Dental anthropology in the AJPA: Its roots and heights. *American Journal of Physical Anthropology*, 165, 879-892.

Hanihara, K. (1961). Criteria for Classification of Crown Characters of the Human Deciduous Dentition. *Journal of the Anthropological Society of Nippon*, 69, 27-45.

Hanihara, K. (1992). Dental and cranial affinities among populations of East Asia and the Pacific. *American Journal of Physical Anthropology*, 88(2), 163-82.

Hernández, J.A., Villavicencio, J., & Moreno, F. (2007). Geminación dental múltiple: Revisión de la literatura y reporte de un caso clínico. *Revista Facultad de Odontología Universidad de Antioquia*, 19(1), 136-142.

Hernández, J., Villavicencio, J., Arce, E., & Moreno, F. (2010). Talón cuspídeo: Reporte de cinco casos. *Revista Facultad de Odontología Universidad de Antioquia*, 21(2), 208-217.

Hernández, J.A, Moreno, S., & Moreno, F. (2015). Origen, frecuencia y variabilidad del protostílido en poblaciones humanas del suroccidente colombiano. Revisión sistemática de la literatura. *Revista Facultad de Odontología Universidad de Antioquia*, 27(1):108-126.

Higa T., Hanihara T., Sunakawa H., & Ishida, H. (2003). Dental Variation of Ryukyu Islanders: A Comparative Study Among Ryukyu, Ainu, and Other Asian Populations. *American Journal of Human Biology*, 15:127-43.

Hillson, S. (1996). *Dental anthropology*. London: Cambridge University Press.

Hurtado, L., Montenegro, L., Pardo, C., Tipas, M., Zuleta, A., Moreno, S., & Moreno, F. Modos de herencia de la morfología dental en familias Misak del municipio de Silvia (Cauca, Colombia). *Jangwa Pana*, 19(2).

Irish, J.D. (1997). Characteristic high- and low-frequency dental traits in Sub-Saharan African populations. *American Journal of Physical Anthropology*, 102(4), 455-67.

López-Lázaro, S., Soto-Álvarez, C., Aramburú, G., Rodríguez, I., Cantín, M., & Fonseca, G.M. (2016). Investigación de rasgos dentales no métricos en poblaciones sudamericanas actuales: estado de situación y contextualización forense. *International Journal of Morphology*, 34 (2), 580-592.

Madsen, R.R. (2019). Scientific impact and the quest for visibility. *The FEBS Journal*, 286, 3968-3974.

Marcovich, I., Prado, E., Díaz, P., Ortiz, Y., Martínez, C., & Moreno, F. (2012). Análisis de la morfología dental en escolares afro-colombianos de Villarica, Cauca, Colombia. *Revista Facultad de Odontología Universidad de Antioquia*, 24(1), 37-61.

Marín, L., Moreno, S., & Moreno, F. (2020). Technical Note: A Systematic Literature Review and Case Report of Bilateral Two-Rooted Mandibular Deciduous Canines and Their Usefulness in Forensic Identification. *Dental Anthropology*, 33 (1), 23-29.

Moreno, F., Moreno, S.M., Díaz, C.A, Bustos, E.A., & Rodríguez, J.V. (2004). Prevalencia y variabilidad de ocho rasgos morfológicos dentales en jóvenes de tres colegios de Cali, 2002. *Colombia Médica*, 35(3-Supl 1), 16-23.

Moreno, F., & Moreno, S. (2016). Patrón cuspídeo de molares inferiores. Revisión de la literatura.

Revista Estomatología, 24(1), 33-9.

Moreno-Gómez, F., González-Colmenares, G., Rojas, M.P. (2019). Morfología dental contemporánea. En C. Sanabria-Medina C (Ed), *Odontología forense: Identificación humana y alteraciones del sistema estomatognático en el contexto forense* (pp. 123-172). Bogotá: Universidad Antonio Nariño.

Moreno, S., & Moreno, F. (2002). Antropología dental: Una herramienta valiosa para fines forenses. *Revista Estomatología*, 10(2), 29-42.

Moreno, S., & Moreno, F. (2005). Eight non-metric dental traits in alive racially mixed population from Cali, Colombia. *International Journal of Dental Anthropology*, 6, 14-25.

Moreno, S., & Moreno, F. (2007). Importancia clínica de la antropología dental. *Revista Estomatología*, 15(2) Supl 1, 42-53.

Moreno, S., & Moreno, F. (2010). Incisivos laterales superiores en forma de barril. Reporte de un caso. *Revista Estomatología*, 18(2), 19-22.

Moreno, S., & Moreno, F. (2016). Cíngulo dental: Revisión de la literatura. *Revista Estomatología*, 24(1), 40-51.

Moreno, S., & Moreno, F. (2017). El cíngulo dental. *Revista Odontológica Mexicana*, 21(1), 6-7.

Moreno-Correa, S.M., & Moreno-Gómez, F. (2021). Clinical implication of protostlylid: A point of view from dental anthropology and non-invasive dentistry. *Revista Facultad de Odontología Universidad de Antioquia*, 33(1), 107-121.

Moreno, S., Reyes, M.P., & Moreno, F. (2016). Cusp expression of protostylid in deciduous and permanent molars. *Journal of Forensic Dental Sciences*, 8(3), 155-63.

Moreno, S., & Moreno, F. (2016). Relación entre antropología dental y ortodoncia: Frecuencia y variabilidad de winging y crowding en cinco grupos étnicos del suroccidente colombiano. *Revista Científica Sociedad de Ortodoncia*, 3(1), 47-57.

Moreno, S., & Moreno, F. (2017). Origen y expresión de la cúspide de Carabelli en diferentes grupos étnicos del suroccidente colombiano: estudio documental. *Revista Nacional de Odontología*, 13(24), 111-121.

Moreno, A.I., Rey-Rocha, J.R., Burgess, S., López-Navarro, I., & Sachdev, I. (2012). Spanish researchers' perceived difficulty writing research articles for English medium journals: the impact of proficiency in English versus publication experience. *Ibérica*, 24, 157-184.

Moorees, C.F.A., Fanning, E.A., & Hunt, E.E. (1963). Age variation of formation stages for ten permanent teeth. *Journal of Dental Research*, 42, 264-73.

Ocampo, A.M., Sánchez, J.D., Martínez, C., & Moreno, F. (2009). Correlación de diez rasgos morfológicos dentales coronales entre molares deciduos y permanentes en tres grupos étnicos colombianos. *Revista Estomatología*, 17(2), 7-16.

Padilla, M., Tello, L., Moreno, F., Osorio, J., & Bedoya, A. (2013). Analysis of dental arch dimensions in three Colombian ethnic groups. *International Journal of Morphology*, 31(1), 100-6.

Parra, L., Hernández, J.A., Moreno, S., & Moreno, F. (2018). Correlación entre el patrón cuspídeo y el pliegue acodado en seis grupos étnicos del suroccidente colombiano. *Revista Facultad de Odontología Universidad de Antioquia*, 29 (2), 383-404.

Pérez, M., Herrera, A., Moreno, S., & Moreno, F. (2016). Estimación de la edad dental a través de seis métodos radiográficos en un grupo de afrodescendientes y mestizos caucasoides. *Cuadernos de Medicina Forense*, 22(3-4), 81-92.

Pérez, C., Sánchez, C., Moreno, S., & Moreno, F. (2017). Frecuencia y variabilidad de la morfología dental de molares temporales y permanentes en un grupo de mestizos caucasoides de Popayán (Cauca, Colombia). *Revista Estomatología*, 25(1), 23-31.

Pilloud, M. A., Skipper, C. E., Horsley, S. L., Craig, A., Latham, K., Clemmons C. M. J., Zejdlik, K., Boehm, D. A., Philbin, C. S. (2021). Terminology Used to Describe Human Variation in Forensic Anthropology. *Forensic Anthropology*, 1-24.

Pizarro, M.A., Martínez, V., Posada, G., Moreno, S., & Moreno, F. (2018). Investigaciones de la Escuela de Odontología de la Universidad del Valle presentadas en los encuentros de la Asociación Colombiana de Facultades de Odontología (ACFO) a 2016: Perfil bibliométrico. *Revista Estomatología*, 26(2), 21-29.

Powell, N., & Humphreys, B. (1984). *Proportions of the Aesthetic Face*. New York: Thieme-Stratton.

Rocha, L., Rivas, H., & Moreno, F. (2007). Frecuencia y variabilidad de la morfología dental en niños afro-colombianos de una institución educativa de Puerto Tejada, Cauca, Colombia. *Colombia Médica*, 38(3), 210-21.

Rodríguez, C., & Moreno, F. (2006). Paramolar tubercle in the left maxillary second premolar. A case report. *Dental Anthropology*, 19(3), 65-69.

Rodríguez, J.V. (2003). *Dientes y diversidad humana: Avances de la antropología dental*. Bogotá: Universidad Nacional de Colombia.

Rodríguez, J.V. (2004). *La antropología forense en la identificación humana*. Bogotá: Universidad

Nacional de Colombia.
Rodríguez, J.V. (2011). *La identificación humana en Colombia: Avances y perspectivas*. Bogotá: Universidad Nacional de Colombia.
Rodríguez, J.V., Polanco, H., Valdés, Y., & Casas, A. (1995). *Odontología forense*. Bogotá: Ecoe ediciones.
Rodríguez, C.D. (2003). Antropología dental en Colombia. Comienzos, estado actual y perspectivas de investigación. *Antropo*, 4, 17-27.
Rodríguez-Flórez, C.D. (2005). La antropología dental y su importancia en el estudio de los grupos humanos. *Revista Facultad de Odontología Universidad de Antioquia*, 16(1-2), 52-9.
Scott, GC., & Turner, CG. (1997). *The anthropology of modern human teeth: dental morphology and its variation in recent human populations*. London: Cambridge University Press.
Scott, G.C., & Turner, C.G. (1998). Dental anthropology. *Annual Review of Anthropology*, 17, 99-126.
Sciulli, P.W. (1998). Evolution of Dentition in Prehistoric Ohio Valley Native Americans: II. Morphology of the Deciduous Dentition. *American Journal Physical Anthropology*, 106, 189-205.
Smith, E.L. (2005). *A test of Ubelaker's method of estimating subadult age from the dentition*. (Master's Degree in Human Biology). Indianapolis: University of Indianapolis, 1-72.
Soto, J., Moreno, S., & Moreno, F. (2010). Antropología dental y periodoncia: Relación entre los rasgos morfológicos dentales y la enfermedad periodontal. *Acta Odontológica Venezolana*, 48(3).
Turner, C.G. (1984). Advances in the dental search for native American origins. *Acta Anthropogen*, 8 (1-2), 23-78.
Turner, C.G. (1990). Major features of Sundadonty and Sinodonty, including suggestions about East Asian microevolution, population history, and late Pleistocene relationships with Australian aboriginals. *American Journal of Physical Anthropology*, 82, 295-317.
van Reenen, F., Reid, C., & Butler, P. (1998). *Morphological studies on human premolar crowns.* In Mayhall, J.T., Heikkinen, T. (Editors). Dental Morphology. Proceedings of the 11th International Symposium on Dental Morphology, Oulu, Finlandia, 192-205.
Zoubov, A.A. (1998). La antropología dental y la práctica forense. *Maguaré*, 13, 243-252.
Zúñiga, S., Moreno, S., & Moreno, F. (2016). Caracterización morfológica de los segundos molares temporales y los primeros molares permanentes de tres grupos étnicos de la región del Chocó (Colombia). *Revista Nacional de Odontología*, 12(22), 43-59.