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PAPER

ANTHROPOLOGY

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Morphoscopic Trait Expressions Used to Identify Southwest Hispanics*

ABSTRACT: Hispanics represent the largest and fastest growing minority in the United States. It is increasingly important to understand the skeletal morphology and regional variation within this diverse group. This research focuses on the eight cranial morphoscopic traits of Southwest Hispanics from Birkby et al. (J Forensic Sci 2008;53(1):29–33) and 18 additional traits. Frequency distributions assessed the prevalence of trait expressions in Southwest Hispanic, African-American, and European-American samples. Forward stepwise discriminant function analysis indicated the best traits for differentiating these three groups. Six of the Birkby et al.'s traits are prevalent in the Southwest Hispanic sample and the best traits to distinguish the three groups are as follows: incisor shoveling, anterior malar projection, nasal sill, oval window visualization, enamel extensions, anterior nasal spine, nasal aperture width, and alveolar prognathism. This research demonstrates the efficacy of morphoscopic traits in ancestry determinations and the utility of the aforementioned traits in discriminating Southwest Hispanics, African Americans, and European Americans.

KEYWORDS: forensic science, forensic anthropology, ancestry, morphoscopic traits, Southwest Hispanic, population affinity, Hispanic, nonmetric traits, ancestry assessment

The accurate assessment of ancestry is an important component of the biological profile and can be accomplished through morphological assessment of morphoscopic skeletal features and metric evaluation. Historically, African, Asian, and European ancestries have been the focus of physical anthropology studies because these once represented the majority of the population of the United States. Today, however, there is much more diversity in the American populace, and it is increasingly evident that there is far greater variation within the three overarching ancestral categories than previously realized. These issues make it challenging for medico-legal professionals relying on traditional methods to make correct ancestral determinations and has made it apparent that additional ancestral categories need to be included in the repertoire of practicing forensic anthropologists. The urgency to include additional groups is emphasized by the substantial increase in the number of individuals classified as Hispanics in the United States. This group is now the largest minority in the United States, but remains relatively unknown in the forensic anthropology literature. Owing to this growing presence in both the general population and forensic anthropology laboratories, research on Hispanics has become a recent focus in anthropological studies (1–3).

As Hispanics now represent the largest and fastest growing minority in the United States (4), it is increasingly important for the forensic anthropologist to understand the range of human variation in this group. Hispanic is defined by the U.S. Census Bureau as any individual originating from Mexico, Puerto Rico, Cuba, Central America, South America, or other Hispanic/Latino origins (5). This definition has no biological basis but rather describes people that share a language, not necessarily a common heritage or ancestral origins. Ross et al. (2) highlight the issues in using this imprecise terminology and warn, "in the forensic setting, the use of such an umbrella term is problematic because it ignores the different ethnohistories and migration patterns of each geographical region" (p.11). Research on the cranial and postcranial metric variation of Hispanics has revealed a large degree of heterogeneity indicating multiple groups that are sufficiently different to be distinguishable (3,6–8). Therefore, research is necessary to understand the biological diversity across regions and establish specific morphological criteria for each regional group.

Research on Hispanic subgroups is in its infancy, but work is being done to characterize this diversity. One example of this type of work is the article by Birkby et al. (1) on skeletal traits used to identify Southwest Hispanics. This article is based on casework from the Pima County Office of the Medical Examiner (PCOME) in Tucson, Arizona, where the forensic anthropologists have the unique challenge of identifying a large number of individuals who have died crossing the Arizona–Mexico border into the United States. Owing to the geographical location, the focus by Birkby et al. (1) was on Southwest Hispanics, defined as populations from Mexico, Latin America, and the southwest United States that display a combination of skeletal traits from both European and Native American ancestral groups. From 2002 to 2007 alone, the PCOME examined the remains of nearly 750 undocumented border-crossers (UBCs). Acute observations of skeletal characteristics from this casework and decades of forensic anthropology work have led these practitioners to utilize a suite of skeletal features to aid in the identification of Southwest Hispanics. While these traits have been employed with success at the PCOME, their prevalence

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within a Southwest Hispanic sample has not been systematically collected and their ability to distinguish Southwest Hispanics from other groups has not been tested. Thus, the purpose of this research is to provide the baseline frequency data for the morphoscopic traits of Birkby et al. (1) and establish a suite of features that can distinguish Southwest Hispanics.

Three research hypotheses were tested by this study, as follows:

- The trait expressions proposed by Birkby et al. (1) will be most prevalent in the Southwest Hispanic sample;
- The Southwest Hispanic sample will be distinguishable from African-American and European-American samples; and
- There will be a suite of morphoscopic traits that best discriminates the Southwest Hispanic, European-American, and African-American samples.

Materials and Methods

A sample of 177 individuals, including 65 Southwest Hispanics, 60 European-Americans, and 52 African Americans was selected for this study (Table 1). Previous work by Hefner (9) found no sex differences in morphoscopic traits allowing the men and women to be pooled within groups. The PCOME in Tucson, Arizona, provided the Southwest Hispanic sample from forensic cases of UBCs positively or contextually identified (10) between 2006 and the summer of 2008. To date, 18 individuals have been positively identified and 47 have strong contextual evidence indicating Southwest Hispanic origins. These individuals were classified as UBCs because they were found near the Arizona–Mexico border, often in known migrant corridors, with physical characteristics and associated artifacts indicative of Southwest Hispanic origin, including Mexican voter registration cards, birth and marriage certificates, foreign currency, and religious icons of the *Virgen de Guadalupe* or local patron saints (10). Skeletal features of interest to this study were scored as remains became available.

The European-American and African-American samples were from the William M. Bass Donated Skeletal Collection housed at the University of Tennessee, Knoxville. This collection of individuals of known sex, age, and ancestry was initiated in 1981 and has continually grown since, currently containing more than 400 skeletal remains. Individuals were included in the sample based on complete and intact crania and presence of dentition, if available.

Cranial Morphoscopic Traits

The first goal of this study was to empirically evaluate the cranial morphoscopic traits utilized by Birkby et al. (1) to classify Southwest Hispanic ancestry. These features included the following: shoveled anterior teeth, anterior malar projection, short posterior occipital shelf, medium to dull nasal sill, little or no oval window visualization, enamel extensions on molars, nasal overgrowth, and wide frontal process of the zygomatic (1). In an attempt to determine the best suite of features for characterizing Southwest Hispanic ancestry, additional promising features were also assessed (Table 2). In total, 26 morphoscopic traits were scored, including eight traits from Birkby et al. (1), 11 traits from Hefner (11), and other traits from Gill (12), Napoli and Birkby (13), Rhine (14), and two that were created from discussions with practitioners. Table 2 lists all of the traits that were scored.

TABLE 1—*Samples scored for cranial morphoscopic traits.*

Ancestry	Male	Female	Total
African American	45	7	52
SW Hispanic	50	15	65
European American	45	15	60
Total	140	37	177

TABLE 2—*Summary of the cranial morphoscopic traits evaluated in this study.*

Cranial Nonmetric Trait	Abbreviation	Source
Anterior malar projection	AMP	Birkby et al. (1)
Nasal sill	NS	Birkby et al. (1)
Oval window visualization	OVAL	Birkby et al. (1)
Occipital shelf	OCCS	Birkby et al. (1)
Incisor shoveling	SHOV	Birkby et al. (1)
Enamel extensions	ENEX	Birkby et al. (1)
Nasal overgrowth	NO	Birkby et al. (1)
Frontal process of the zygomatic	FPROC	Birkby et al. (1)
Anterior nasal spine	ANS	Hefner (11)
Interorbital breadth	IOB	Hefner (11)
Malar tubercle	MT	Hefner (11)
Nasal aperture shape	NAS	Hefner (11)
Nasal aperture width	NAW	Hefner (11)
Nasal bone contour	NBC	Hefner (11)
Nasal bone shape	NBS	Hefner (11)
Postbregmatic depression	PBD	Hefner (11)
Supranasal suture	SPS	Hefner (11)
Transverse palatine suture	TPS	Hefner (11)
Zygomaticomaxillary suture	ZMS	Hefner (11)
Palate shape	PALS	Gill (12)
Shape of porous opening	PORO	Napoli and Birkby (13)
Venous markings	VM	Rhine (14)
Prognathism	PROG	Rhine (14)
Wormian bones	WORM	Rhine (14)
Palate depth	PALD	Hurst
Palate morphology	PALM	Hurst

The scoring criteria for each of the selected traits were either adopted from previous work or created for this study. The 11 traits from Hefner (11) were accompanied by drawings and detailed descriptions of each trait expression. Similarly, drawings for incisor shoveling from Hrdlička (15) and palate shape from Gill (12) were utilized. Drawings and descriptions for the remaining 13 traits were created to capture the variation while keeping the scoring simple and repeatable. Dr. Walter Birkby on this subject acknowledged that although the Birkby et al. (1) traits were presented in a dichotomous fashion, there were intermediate expressions that should be characterized (W. H Birkby, personal communication). Thus, character states were created to reflect the intermediate nature of certain morphoscopic traits.

Utilizing the drawings and descriptions, the 26 morphoscopic traits were scored on each individual if crania were present and complete. A subsample of 30 crania was rescored for tests of intra-observer error. The results were then entered into SPSS Statistics 17.0 Statistical Program for evaluation (16). Descriptive cross-tabulation tables and bar charts were produced to evaluate the most frequent trait expressions in each ancestral group for all individual morphoscopic traits. Cohen's kappa statistic was used to assess intra-observer variability by measuring the level of agreement between the two observations, with scores of $k = 1$ indicating perfect agreement (11). Discriminant function analysis (DFA) was utilized to determine which traits best differentiated the three ancestral groups. DFA is a statistical test that is easily utilized and readily available in most statistical packages, but it must be noted that morphoscopic data may violate some of the assumptions of this method. In particular, the assumptions of normal distribution and the equality of variance/covariance matrices may not be fulfilled using these data (17). It has been found, however, that the results of DFA remain relatively strong despite minor violations of these

assumptions (18). Thus, it was determined that the practical application of DFA, with minor consequences, was warranted in this investigation despite the problematic form of the data.

DFA creates a predictive model for group membership based on the combination of traits that provides the best discrimination among the three samples (16). A stepwise procedure, which eliminates the variables with the least discriminatory power, was employed to reduce the number of traits and enhance the accuracy of the final predictive model (19). The DFA calculated group centroids to represent the means of all of the variables used to define a particular group (20). Mahalanobis distance was then employed to classify an individual into a population based on the group centroid to which they were closest (20). In addition, cross-validation was accomplished via leave-one-out classification, where a single individual of known group affiliation was removed from contributing to the discriminant function and then used to test the predictive value of the model (19). This process was then repeated with every other applicable individual and the results provided the cross-validated classification accuracy of the discriminant model (19).

Results

The first hypothesis of this project was to test whether the Birkby et al. (1) trait expressions were found in the majority of individuals of the Southwest Hispanic sample. Table 3 shows the Birkby et al. (1) traits as they were scored and compares the hypothesized trait expressions with the results of this study. To reflect the dichotomous nature of the original Birkby et al. (1) trait list, Table 4 collapses the trait expressions of incisor shoveling (shoveled vs. not shoveled), anterior malar projection (projecting vs. not projecting), and nasal sill (sharp vs. blunt). Table 4 confirms that six of the eight Birkby et al. (1) trait expressions were found in the majority of the Southwest Hispanic sample. The most prevalent traits were as follows: incisor shoveling (96.7%), moderate to strong anterior malar projection (96.7%), and enamel extensions (81.8%). These traits were closely followed by: blunt to guttered nasal sill (79.0%), wide frontal process of the zygomatic (with tubercle) (74.2%), and little to no oval window visualization (66.7%). Nasal overgrowth (40.9%) and short occipital shelf (27.0%) failed to appear in the majority of the sample. However, as will be discussed, this does not signify uselessness in ancestral determinations.

The second goal of this project was to evaluate the Birkby et al. (1), Hefner (11), and other morphoscopic traits for their efficacy in discriminating Southwest Hispanics from those of European and African ancestries. The 26 morphoscopic traits scored were also statistically evaluated using DFA. All of the traits were tested together as a whole and the Birkby et al. (1) traits were isolated to assess their efficacy in discriminating between the three samples. To perform the DFA, individuals needed to have all variables present. Thus, in the analysis of the complete list of 26 traits, only 81 individuals were included and only 84 cases could be used to assess the eight Birkby et al. (1) traits. This is a reflection of the samples. The Southwest Hispanic skeletons were often fragmentary and/or incomplete because of taphonomic processes, while the European-American and African-American samples contained many elderly individuals who were often edentulous with no teeth available to score.

Utilizing the forward stepwise discriminant function of SPSS Statistics 17.0, eight of the 26 traits were found to best differentiate the three samples, including: incisor shoveling, anterior malar projection, nasal sill, oval window visualization, enamel extensions, anterior nasal spine, nasal aperture width, and prognathism (Table 5). These traits represent the morphoscopic features with the strongest ability to discriminate between Southwest Hispanics, African Americans, and European Americans. It should be recognized that five of the eight Birkby et al. (1) traits were among the strongest discriminating variables. These eight traits performed remarkably well in classifying individuals into ancestral groups with 91.9% of the cross-validated grouped cases correctly classified (Table 6). When only evaluating the Birkby et al. (1) traits, the cross-validation accuracy was reduced to 82.1% (Table 7) and only the frontal process of the zygomatic was eliminated in the stepwise process (Table 8). In neither DFAs was the frontal process of the zygomatic included indicating its weak predictive ability in distinguishing ancestral affiliation.

Results of the intra-observer analysis indicate small levels of variation between the initial observation and the rescoring. Table 9 shows the intra-observer error results for the eight most discriminating traits. Nasal sill ($k = 0.554$) and prognathism ($k = 0.585$)

TABLE 3—*Comparison of trait expressions predicted by Birkby et al. (1) for Southwest Hispanics and results from this study.*

Birkby et al. (1) Trait	Degrees of Expression		
Incisor shape	Shoveled*†	No shovel	
Anterior malar projection	No projection	Moderate projection*†	Strong projection*
Occipital shelf	Short*	Moderate†	Long
Nasal sill morphology	Guttered	Blunt*†	Sharp
Oval window visualization	Non-visualization*	Partial visualization*†	Full visualization
Enamel extensions	Absent	Present*†	
Nasal overgrowth	Absent†	Present*	
Frontal process of zygomatic	Narrow	Wide*†	

*Predicted by Birkby et al. (1).
†Trait expression with highest frequency in the Southwest Hispanic sample.

TABLE 4—*Frequency of Birkby et al. (1) trait expressions in Southwest Hispanic sample.*

Nonmetric Trait Expression	*N* (%)
Shoveling	29 (96.7)
Anterior malar projection	59 (96.7)
Enamel extensions	45 (81.8)
No sharp nasal sill	49 (79.0)
Wide frontal process	46 (74.2)
Little to no oval window	42 (66.7)*
Nasal overgrowth	18 (40.9)*
Short occipital shelf	17 (27.0)*

*See Discussion for explanation of these traits.

TABLE 5—*Traits used in discriminant function analysis for all cranial traits.*

Standardized Canonical Discriminant Function Coefficients		
	Function	
	1	2
Incisor shoveling	0.556	0.021
Anterior malar projection	−0.336	0.264
Nasal sill	0.386	−0.467
Oval window visualization	0.400	0.224
Enamel extensions	−0.595	−0.020
Anterior nasal spine	−0.508	−0.441
Nasal aperture width	0.425	0.286
Prognathism	−0.016	0.599

TABLE 6—*Cross-validation results of all 26 traits.*

		Classification Results*†			
		Predicted Group Membership			
	Ancestry	African American	SW Hispanic	European American	Total
Original					
Count	African American	26	2	2	30
	SW Hispanic	1	26	0	27
	European American	1	1	27	29
Percent	African American	86.7	6.7	6.7	100.0
	SW Hispanic	3.7	96.3	0.0	100.0
	European American	3.4	3.4	93.1	100.0
Cross-validated‡					
Count	African American	26	2	2	30
	SW Hispanic	1	26	0	27
	European American	1	1	27	29
Percent	African American	86.7	6.7	6.7	100.0
	SW Hispanic	3.7	96.3	0.0	100.0
	European American	3.4	3.4	93.1	100.0

*91.9% of original grouped cases correctly classified.
†91.9% of cross-validated grouped cases correctly classified.
‡Cross-validation is carried out only for those cases in the analysis. In cross-validation, each case is classified by the functions derived from all cases other than that case.

TABLE 7—*Cross-validation results for the eight Birkby et al. (1) traits.*

		Classification Results*†			
		Predicted Group Membership			
	Ancestry	African American	SW Hispanic	European American	Total
Original					
Count	African American	20	3	7	30
	SW Hispanic	1	24	0	25
	European American	2	0	27	29
Percent	African American	66.7	10.0	23.3	100.0
	SW Hispanic	4.0	96.0	0.0	100.0
	European American	6.9	0.0	93.1	100.0
Cross-validated‡					
Count	African American	20	3	7	30
	SW Hispanic	2	23	0	25
	European American	3	0	26	29
Percent	African American	66.7	10.0	23.3	100.0
	SW Hispanic	8.0	92.0	0.0	100.0
	European American	10.3	0.0	89.7	100.0

*84.5% of original grouped cases correctly classified.
†82.1% of cross-validated grouped cases correctly classified.
‡Cross-validation is carried out only for those cases in the analysis. In cross-validation, each case is classified by the functions derived from all cases other than that case.

TABLE 8—*Traits used in discriminant function analysis of the Birkby et al. (1) traits.*

Standardized Canonical Discriminant Function Coefficients		
	Function	
	1	2
Incisor shoveling	0.518	−0.057
Anterior malar projection	−0.431	−0.293
Occipital shelf	0.387	−0.234
Oval window visualization	0.321	−0.274
Enamel extensions	−0.541	0.347
Nasal overgrowth	−0.330	0.209
Nasal sill	0.318	0.865

TABLE 9—*Intra-observer analysis results of the top eight traits.*

Trait	Cohen's *k*
Shoveling	1.00
Anterior malar projection	1.00
Nasal sill	0.554
Oval window	0.842
Enamel extensions	0.882
Anterior nasal spine	0.801
Nasal aperture width	0.920
Prognathism	0.585

displayed lower intra-observer agreement than the other traits. The poor concordance for scoring of the nasal sill may stem from the difficulty of assigning a score to those individuals who display slightly different morphologies of the sill on their left and right sides. The surprising low intra-observer agreement for prognathism may be the result of coding error or an indication that the descriptions and drawings used for the trait expressions of prognathism need to be improved. Overall, however, the high intra-observer scores suggest these traits can be reliably scored, adding to their utility as morphoscopic traits.

Discussion

Overall, the Birkby et al. (1) traits performed admirably with six present in high frequencies in the Southwest Hispanic sample (Table 4) and seven used in the DFA with a cross-validation of 82.1% (Tables 7 and 8). Despite these positive results, the low frequencies of nasal overgrowth and short occipital shelf in the Southwest Hispanic sample and the poor predictive ability of the frontal process of the zygomatic warrant further discussion.

The occurrence of nasal overgrowth was one of the Birkby et al. (1) traits that did not perform as expected. The majority of the Southwest Hispanic sample displayed no nasal overgrowth (59.1% or 26/44), however, of the individuals that did display nasal overgrowth, the majority were of Southwest Hispanic descent (54.5% or 18/33) (Table 10). Thus, nasal overgrowth may not be a trait that is expected in all Southwest Hispanic individuals, but, if present, may indicate a person of this ancestry.

A short occipital shelf was another trait with low frequencies among Southwest Hispanics. Although Birkby et al. (1) reported a

TABLE 10—*Descriptive statistics of prevalence of nasal overgrowth expressions in the three samples.*

Nasal Overgrowth Cross-Tabulation			
	Nasal Overgrowth		
	Absent	Present	Total
Sample			
African American			
Count	45	7	52
Percent in sample	86.5	13.5	100.0
Percent in nasal overgrowth	37.2	21.2	33.8
SW Hispanic			
Count	26	18	44
Percent in sample	59.1	40.9	100.0
Percent in nasal overgrowth	21.5	54.5	28.6
European American			
Count	50	8	58
Percent in sample	86.2	13.8	100.0
Percent in nasal overgrowth	41.3	24.2	37.7
Total			
Count	121	33	154
Percent in sample	78.6	21.4	100.0
Percent in nasal overgrowth	100.0	100.0	100.0

short occipital shelf, the majority (57.1% or 36/63) of the Southwest Hispanic sample displayed a moderate length of occipital shelf (Table 11). This expression is intermediate between the long occipital shelf of European Americans and the short occipital shelf observed in prehistoric Southwest Native Americans. The difference observed in the expression of this trait is probably one of interpretation. While three character states for the occipital shelf were utilized in this study, the Birkby et al. (1) authors defined a "short occipital shelf" as the absence of a long occipital shelf (T. W. Fenton, personal communication). Therefore, the results in this study would support Birkby et al. (1) as the European-American and African-American samples predominantly displayed long occipital shelves while the vast majority of Southwest Hispanics (84.1% or 53/63) did not have a long occipital shelf.

A wide frontal process of the zygomatic was the single trait eliminated in the DFA of the Birkby et al. (1) traits. This suggests that it has poor predictive ability to separate the three samples. As was predicted by Birkby et al. (1), it was the trait expression most seen in the Southwest Hispanic group (74.2% or 46/62), however, it was also the most common trait expression in the African-American (57.7% or 30/52) and European-American (56.7% or 34/60) groups as well (Table 12). A wide frontal process of the zygomatic was not a trait indicative of a particular ancestral group and was eliminated in the stepwise process of the DFA.

The combined expressions of partial to no visualization in the oval window trait was found in the majority of the Southwest Hispanic sample, but a discrepancy in the expression of oval window visualization in the Birkby et al. (1) article was raised by one of the authors (T. W. Fenton, personal communication). Referring to the original Napoli and Birkby (13) publication in the edited volume *The Skeletal Attribution of Race* (21), it is reported that complete oval window visualization occurred in 69% of the admixed sample and partial visibility in the remaining 32%. Thus, the Birkby et al. (1) article should have reported that partial to full visibility was the expected expression for oval window visualization in Southwest Hispanics. In this case, the data presented here are actually much stronger with 87.3% (55/63) of the sample displaying partial to full oval window visibility (Table 13).

Another surprising result was the high frequency of nasal guttering in the Southwest Hispanic sample. According to Birkby et al. (1), Southwest Hispanics should display a, "less elaborate nasal sill (tending toward dull)" (p. 31). Although the expression of a blunt nasal sill had the highest frequency (46.8% or 29/62), guttering was expressed in 32.3% (20/62) of the Southwest Hispanic sample (Table 14). This was higher than the African-American group that only had a frequency of 25.0% (13/52) for guttering with the majority scored as blunt (59.6% or 31/52). These results warrant a further investigation into the guttering trait and whether it is actually a distinguishing feature of African ancestry, as traditionally

TABLE 11—*Descriptive statistics of prevalence of occipital shelf expressions in the three samples.*

	Occipital Shelf Cross-Tabulation			
	Occipital Shelf			
	Short	Moderate	Long	Total
Sample				
African American				
Count	4	15	33	52
Percent in sample	7.7	28.8	63.5	100.0
Percent in occipital shelf	16.7	20.3	42.9	29.7
SW Hispanic				
Count	17	36	10	63
Percent in sample	27.0	57.1	15.9	100.0
Percent in occipital shelf	70.8	48.6	13.0	36.0
European American				
Count	3	23	34	60
Percent in sample	5.0	38.3	56.7	100.0
Percent in occipital shelf	12.5	31.1	44.2	34.3
Total				
Count	24	74	77	175
Percent in sample	13.7	42.3	44.0	100.0
Percent in occipital shelf	100.0	100.0	100.0	100.0

TABLE 12—*Descriptive statistics of prevalence of frontal process of the zygomatic expressions in the three samples.*

	Frontal Process of the Zygomatic Cross-Tabulation		
	Frontal Process of the Zygomatic		
	No to weak Projection	Moderate to Marked Projection	Total
Sample			
African American			
Count	22	30	52
Percent in sample	42.3	57.7	100.0
Percent in frontal process	34.4	27.3	29.9
SW Hispanic			
Count	16	46	62
Percent in sample	25.8	74.2	100.0
Percent in frontal process	25.0	41.8	35.6
European American			
Count	26	34	60
Percent in sample	43.3	56.7	100.0
Percent in frontal process	40.6	30.9	34.5
Total			
Count	64	110	174
Percent in sample	36.8	63.2	100.0
Percent in frontal process	100.0	100.0	100.0

TABLE 13—*Descriptive statistics of the prevalence of oval window visualization expressions in the three samples.*

	Oval Window Visualization Cross-Tabulation			
	Oval Window Visualization			
	Non-visualization	Partial Visualization	Full Visualization	Total
Sample				
African American				
Count	1	14	36	51
Percent in sample	2.0	27.5	70.6	100.0
Percent in oval window	11.1	23.7	36.0	30.4
SW Hispanic				
Count	8	34	21	63
Percent in sample	12.7	54.0	33.3	100.0
Percent in oval window	88.9	57.6	21.0	37.5
European American				
Count	0	11	43	54
Percent in sample	0.0	20.4	79.6	100.0
Percent in oval window	0.0	18.6	43.0	32.1
Total				
Count	9	59	100	168
Percent in sample	5.4	35.1	59.5	100.0
Percent in oval window	100.0	100.0	100.0	100.0

TABLE 14—*Descriptive statistics of the prevalence of nasal sill expressions in the three samples.*

	Nasal Sill Cross-Tabulation			
	Nasal Sill			
	Guttered	Blunt	Sharp	Total
Sample				
African American				
Count	13	31	8	52
Percent in sample	25.0	59.6	15.4	100.0
Percent in nasal sill	37.1	44.9	11.4	29.9
SW Hispanic				
Count	20	29	13	62
Percent in sample	32.3	46.8	21.0	100.0
Percent in nasal sill	57.1	42.0	18.6	35.6
European American				
Count	2	9	49	60
Percent in sample	3.3	15.0	81.7	100.0
Percent in nasal sill	5.7	13.0	70.0	34.5
Total				
Count	35	69	70	174
Percent in sample	20.1	39.7	40.2	100.0
Percent in nasal sill	100.0	100.0	100.0	100.0

thought, or if it needs to be removed or reclassified in ancestral morphoscopic trait studies.

The variable degrees of European and Native American ancestry in Southwest Hispanics was recognized by both Rhine (14) and Birkby et al. (1). Ideally, a modern Southwest Native American sample would have been included to directly test the hypothesis that Southwest Hispanics have morphoscopic morphology with variable degrees of admixture along a continuum from Native American to European expressions. Unfortunately, a modern Southwest Native American sample was unknown. However, based on Rhine's (14) work on cranial morphology of Native Americans, a number of traits, including nasal spine, anterior malar projection, oval window visualization, and occipital shelf do appear to be intermediate in nature and thus demonstrate the influence of admixture. Additionally, Birkby et al. (1) state, "Individuals of Southwest Hispanic ancestry display the impact of European (predominantly Spanish) gene flow on the Native American gene pool" (p. 31). This suggests the predominance of Native American ancestry with some gene flow from European ancestry. This also seems to be reflected in this research with high frequencies of particular traits associated with Native American ancestry, like incisor shoveling and enamel extensions. Interestingly, research by Allard et al. (22) on mitochondrial DNA of Hispanic groups found that the southwestern sample showed 79.9% Native American haplogroups and 15.5% of European haplogroups. This contrasted with the other Hispanic sample that displayed fewer Native American haplogroups (65.3%), more African haplogroups (15.7%) and slightly more European influence (19%).

In summary, the high cross-validation accuracy and intra-observer agreement achieved in this study indicates that morphoscopic trait evaluation has utility in determining ancestral affinity. The efficacy of the Birkby et al. (1) traits in identifying Southwest Hispanics was confirmed by both their high frequencies in individuals of the Southwest Hispanic sample and their discriminatory ability with a high cross-validated classification rate of 82.1%. While these traits provided a strong performance, the higher cross-validation accuracy of 91.9% achieved with the inclusion of traits from Hefner (11) and Rhine (14) suggest that additional traits should be added to the suite of discriminating features. With Hispanics now representing both the largest and fastest growing minority in the United States, regional Hispanic classifications need to be added to the forensic anthropologist's repertoire of ancestral groups. Based on this research, the suite of trait expressions that characterize a Southwest Hispanic (Table 15) are:

- *Shoveled incisors:* Lingual surface with a distinct enamel rim.
- *Moderate anterior malar projection:* Assessed from a basilar view and best visualized with a pencil lying across the nasal aperture. Moderate projection means there is a small space between the pencil and the malars while the malars maintain a rounded appearance (not flattened anteriorly).
- *Blunt to guttered nasal sill:* A rounded area of transition from the horizontal floor of the nasal aperture to the vertical portion of the maxilla that may or may not demonstrate slight to pronounced parallel indentations (guttering).
- *Partially visible oval window:* The oval window, located postero-superiorly within the external auditory meatus and superior to the rounded cochlear window, cannot be completely visualized owing to the projection of the posterior wall of the external auditory meatus.
- *Enamel extensions on molars:* Areas of enamel that extend into the crevice between the roots on the neck of the tooth.
- *Intermediate anterior nasal spine:* A moderate projection of the anterior nasal spine beyond the inferior nasal aperture.
- *Medium nasal aperture width:* The nasal aperture has a moderate width, neither pinched nor rounded.
- *Alveolar prognathism:* The alveolus projects anteriorly below the nasal aperture.

This study demonstrates the morphoscopic cranial differences of Southwest Hispanic, African-American, and European-American samples. These results support the need for further research on the local level, especially on other regional Hispanic groups. In addition, serious consideration should be given to abandoning the nonbiologically meaningful term "Hispanic" altogether and replacing it with terminology aligned with the ancestral categories that are currently in place. Equipped with a better understanding of regional variation and trained to recognize such differences, forensic anthropologists can increase their precision in the estimation of ancestral affinity.

TABLE 15—*Cranial morphoscopic trait frequencies in Southwest Hispanics.*

Trait	Frequency of Expression			
Incisor shoveling	Shovel = 6.7%	Semishovel = 63.3%	Trace shovel = 26.7%	No shovel = 3.3%
Anterior malar projection	None = 3.3%	Moderate = 88.5%	Strong = 8.2%	
Nasal sill	Guttered = 32.3%	Blunt = 46.8%	Sharp = 21.0%	
Oval window	None = 12.7%	Partial = 54.0%	Full = 33.3%	
Enamel extensions	Absent = 18.2%	Present = 81.8%		
Anterior nasal spine	Slight = 22.6%	Intermediate = 39.6%	Marked = 37.7%	
Nasal aperture width	Narrow = 27.9%	Medium = 57.4%	Broad = 14.8%	
Prognathism	Absent = 43.5%	Present = 56.5%		

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