The evaluation of non metric cranial traits used to determine ancestry from skeletal remains

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Introduction

Although true biological 'races' do not exist, authorities are often call upon the expertise of an anthropologist to assign an ancestral label, as well as information pertaining to sex, age and stature, to an unknown person. At the turn of the twentieth century, Hooten (1930) created the Harvard List in which 102 non-metric traits had been systemically characterized and classified among three groups, namely Caucasoid, Negroid or Mongoloid. In time, the Harvard List became standard practice in most anthropological laboratories. Numerous studies have been dedicated to the distribution and biological importance of these non-metric traits, but the applicability of them on groups outside of North America has never been tested.

Aim

The purpose of this study is to evaluate the distribution of standard non-metric traits from the mid-facial region on South African groups.

Materials and Methods

The sample comprised of 520 randomly selected crania of known sex, age, and ancestry which was sourced from different skeletal collections in South Africa, namely the PBC (UP), the Kirsten collection (US), the student bone collection of the University of the Free State, and the Raymond Dart collection of the University of the Witwatersrand (see Table 1). Age at death ranged from 18 to 90 years. Skeletal material with obvious bone pathology was excluded.

Table 1. Sample size: sex, ancestry and skeletal collection

N=520	White		Black		Coloured	
	M	F	M	F	M	F
UP	32	15	100	41	0	0
US	1	1	12	2	61	22
UFS	0	0	23	9	0	0
WITS	61	48	0	50	26	16
Total	94	63	135	102	87	38
Total	158		237		125	

Four standard non-metric cranial traits were morphological scored on three socially defined South African groups (White, Black and Coloured). Standard definitions were obtained from multiple authors such as Bass (1995), Hefner (2003), and Rhine (1990). The variables include nasal breadth (NB), the anterior nasal spine (ANS), inferior nasal margin (INS) and alveolar prognathism (AP).

Characteristic variants of nasal breadth (NB) are described when the skull is in an anterior position and include: narrow, medium, and wide. In Figure 1, narrow morphology (1) is teardrop in shape and corresponds to Caucasoid (European) persons, whereas medium refers to bell-shaped aperture, which is a wide lateral projection of the nasal opening coupled with a superior constriction (2), this trait is most often found in Mongoloids (Asians). In contrast, a wide nasal breadth (3) fills a large portion of the face, with the greatest lateral projection near the horizontal midline and is frequently observed in Negroids (Africans) (Rhine, 1990; Bass, 1995; Hefner, 2003)

Distinguishing morphological features for the anterior nasal spine (ANS) can be seen in Figure 2. Hefner (2003) used the distance between the spine and the prosthion to score this trait, which can be short (rounded) (0), dull (1), medium (2), and long (3) (sharp). The short (rounded) spine has minimal-to-no-projection, and is similar to a dull nasal spine which is only slight more projected; neither the short nor the dull spine crosses the prosthion. A medium projection refers to the spine projecting to the prosthion, while a long and sharp spine projects beyond the prosthion. A score of 0 and 1 were coupled with Africans, 2 corresponds with Asians, and 3 to Europeans.

The most inferior part of the nasal aperture, when combined with the lateral alae, constitutes the inferior nasal margin (INM) (see Figure 3). Variants accompanying this trait include guttered [0], incipient guttering (1), straight (2), a partial sill (3), and a complete sill (4). Guttering is described as a gradual sloping of the nasal floor, which occurs from the vomer to the vertical surface of the maxilla. Incipient guttering is similarly defined but the sloping commences more anteriorly to the maxilla. A straight margin is characterized by an immediate transition from the nasal floor to the maxilla. A partial sill has a diminutive vertical ridge of bone, stretching between the two alae. When the ridge becomes pronounced, it prevents a smooth transition from the nasal floor to the vertical portion of the maxilla, and is then considered as a complete sill (Rhine 1990; Hefner 2003). An inferior nasal margin score of 0 and 1 has been traditionally associated with African groups (1), while Asians have been shown to demonstrate straight nasal margins (2) with Europeans most often found with partial (3) or complete sills (4).

Bass (1995) explained the method that is often used to record alveolar prognathism (AP). He instructs the observer to place the end of a pencil "on or near the anterior nasal spine at the base of the nasal aperture." The pencil should be lowered "towards the face until it touches the chin." By doing this, the face will either appear flat (orthognathic) or exhibit protrusion of the maxillary region, known as prognathism (Bass, 1995). A score of 1 indicates a flat (orthognathic) face which is characteristic of a European or Asian facial profile, whereas a score of 2, which indicates prognathism, is often seen in African groups.

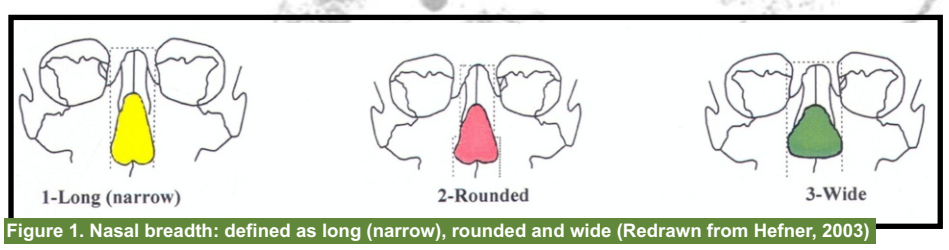

Figure 1. Nasal breadth: defined as long (narrow), rounded and wide (Redrawn from Hefner, 2003)

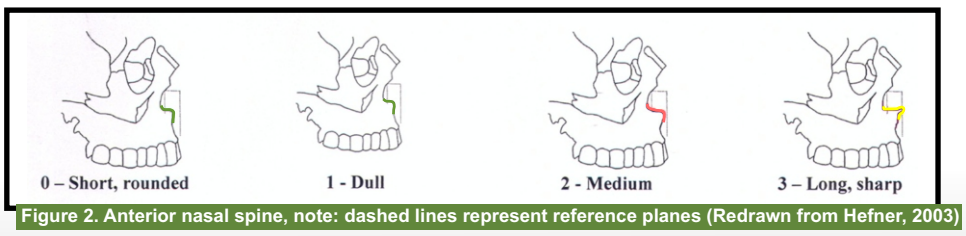

Figure 2. Anterior nasal spine, note: dashed lines represent reference planes (Redrawn from Hefner, 2003)

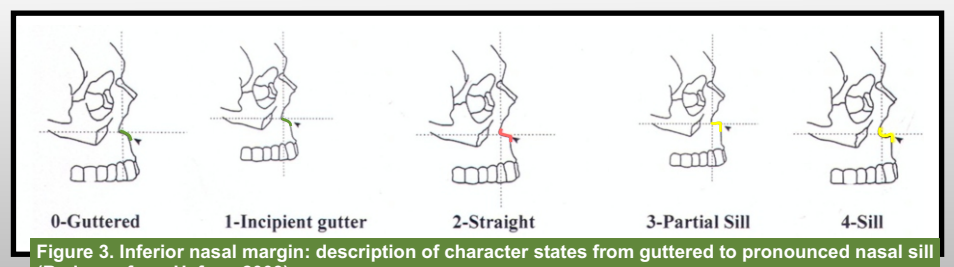

Figure 3. Inferior nasal margin: description of character states from guttered to pronounced nasal sill (Redrawn from Hefner, 2003)

Results

When compared to North American standards for nasal breadth (see Table 2), South Africans, which included 53% of whites, 84% of blacks and 90% of Coloured persons, fell within the intermediate, or Asian, group. The remainder of the white sample had 'narrow' nasal apertures; however, only 12% of black South Africans had a characteristic wide nasal breadth.

In Table 3, the inferior nasal margin was well-developed in white South Africans (80%), which is consistent with previous research; however, the majority of black and coloured groups were classified as either being smooth and guttered or having distinct nasal margins. With this overlap of continuous traits, the inferior nasal margin is not useful in excluding one group from another.

The anterior nasal spine was found to be long in 58% of white persons (see Table 4), whereas, black and coloured groups were more variable with short, dull and medium spines. In Table 5, white individuals tend to not exhibit alveolar prognathism; however, no clear distinction can be made between black and coloured groups. Therefore, this trait may be useful in excluding European from other groups.

Table 2. Frequency: nasal breadth

	White	Black	Coloured
	n 158	n 237	n 125
	%	%	%
1 European	40	0.4	5
2 Asian	53	84	90
3 African	0.6	12	4

Table 3. Frequency: inferior nasal margin

	White	Black	Coloured
	n 158	n 237	n 125
	%	%	%
0 African	93	34	27.2
1 African	34	21	17
2 Asian	12	5	4
3 European	52	39	31.2
4 European	43	23	18.4

Table 4. Frequency: anterior nasal spine

	White	Black	Coloured
	n 158	n 237	n 125
	%	%	%
0 African	7	41	40
1 African	5	33	45
2 Asian	25	20	14
3 European	58	4.2	5

Table 5. Frequency: alveolar prognathism

	White	Black	Coloured
	n 158	n 237	n 125
	%	%	%
1 European & Asian	62	34	42
2 African	10	45	26

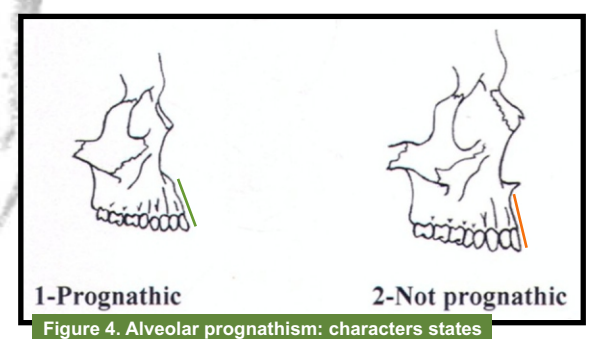

Figure 4. Alveolar prognathism: characters states (redrawn from Hefner, 2003)

Discussion

Forensic anthropologists frequently use non-metric traits from the mid-facial region to attribute ancestry to skeletal remains. The distribution of non-metric features, namely nasal breath, inferior nasal margin, anterior nasal spine and alveolar prognathism in a South African sample was presented, and the results demonstrated distinct differences in the distribution of these non-metric traits among South Africans when compared to North Americans, from which these standards were originally developed.

The questions that should now be asked is whether non-metric traits should be deemed to be population specific, such as the determination of sex or stature, and thus unique traits should be developed for Southern African groups? Or are we dealing with far more complex type of genetic inheritance that these morphological feature may not have be truly associated with ancestral differences?

Conclusion

Ancestry is the most difficult aspect to determine in any demographic profile; these preliminary results warrants further investigation into the application of current standard methodology to South African groups. This research forms part of a larger MSc project in which these traits, and others, are to be correlated with sex, age and each other to explain the relationship between these variables and ancestry. Inter and intra-observer error will be performed so as to test the overall reliability and repeatability of these characteristics.

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References

Bass, WM (1987) Human Osteology: A Laboratory and Field Manual. 3rd Edition. Columbia: Missouri Archaeological Society.
Hefner JT. (2003) Assessing nonmetric cranial traits currently used in forensic determination of ancestry. University of Florida: MSc thesis.
Hooten, EA (1930) The Indians of Pecos Pueblo. Yale University Press, New Haven.
Rhine, S (1990) Nonmetric Skull Racing. In Skeletal Attribution of Race: Methods for Forensic Anthropology, edited by Gill and Rhine, pp. 7-20. Albuquerque, New Mexico: Maxwell Museum of Anthropology.

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