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A Summary of the Skeletal Biology of South America

Introduction

The purpose of this paper is to summarize the studies carried out in the field of physical anthropology in South America. The primary aspects of the study of physical anthropology are to establish, from a morphological point of view, the similarities and/or differences between populations of a particular geographic region (Munizaga 1980:124). The principle method of accomplishment is based on the comparative study of skeletal size and shape; in South America the most important analysis is that of the skull (Munizaga 1980:124).

Research of skeletal material has been focused around studies of the skull (Stewart and Newman 1963:19). Much of the skeletal biology realized is of archaeological material. The studies carried out center around archaeological finds such as mummies and Pre-Columbian individuals. Much work needs to be done on modern populations. The research studies of skeletal material are few and are centered around specific regions, many geographical regions have not been accounted for.

Craniometric Variation

Much work has been done in the area of craniometric variations in prehistoric Andean populations. Such studies have been found to facilitate the reconstruction of the biological human history of the area (Rothhammer et al. 1981:276). The analysis by Rothhammer et al. (1982) revealed that in general "males are more

similar to females in their own group than to females in other groups", differences in shape being more valuable than those of size.

An abundance of studies in skeletal biology express the desire for knowledge concentrated around finding out migration routes via craniometric differentiation, genetic variability between populations (Rothhammer 1989:403) and morphological distances in pre-hispanic populations (Oricot 1976). In another study by Rothhammer et al. (1981) between the populations of EJ Laucho and Alto Ramirez, no difference was found between populations. The similarities are more pronounced amongst the women (Tables 1a and 1b). In the study carried out by Cocilovo et al. (1982) on the microevolution of the Andean area, they took into consideration both deformed and normal skulls. They concluded that the principle factor of variation between populations was sexual dimorphism.

Table 1a. Percentages separated by sex of craniometric measurements in five prehistoric populations of Africa - Males.

	Measurement (*)								
Group	1	2	3	4	5	6	7	8	9
Camarones 14	9.62	13.18	9.38	6.90	4.98	3.95	3.40	5.19	3.19
Morro de Arica	9.60	13.46	9.78	7.05	5.07	3.90	3.52	4.41	3.40
El Laucho	9.09	13.68	10.32	6.85	4.90	3.64	3.44	5.27	3.64
Alto Ramirez	8.62	13.30	10.17	6.97	4.75	3.59	3.52	4.94	3.87
Playa Miller 4	8.86	13.56	10.01	6.66	4.73	3.49	3.40	4.94	3.83

1. Minimum frontal breadth
2. Bizygomatic breadth
3. Alveolo-basilar diameter
4. Nasio-alveolar height
6. Altura de la nariz
6. Nose breadth
7. Orbital height
8. Palate length
8. Palate breadth

(compiled from Rothhammer et at. 1981).

T.O. Stewart (1943a) claimed that low-headedness found amongst western North American population groups and in northern geographical areas of South American delineated a continuous late migration route. These low-heads represent a late migration from Asia. This distribution of low-headedness as well as the

absence of low-headedness amongst the more ancient populations appears to support his theory.

Table 1b. Percentages separated by sex of craniometric measurements in five prehistoric populations of Africa - Females.

Group	Measurement (*) 1	2	3	4	5	6	7	8	9
Camarones 14	8.76	12.19	8.76	6.40	4.46	3.70	3.40	4.36	3.40
Morro de Arica	9.18	12.57	9.25	6.58	4.79	3.84	3.49	4.26	3.27
El laucho	8.65	12.78	9.71	6.51	4.70	3.66	3.47	4.75	3.52
Alto Ramirez	8.33	12.30	9.39	6.33	4.60	3.50	3.33	4.80	3.53
Playa Miller 4	8.55	12.69	9.78	6.51	4.46	3.36	3.29	4.72	3.67

(*) 1. Minimal frontal breadth
2. Bizygomatic breadth
3. Alveolo-basila diameter
4. Nasio-alveolar height
6. Altura de le nariz
6. Nose breadth
7. Orbitel height
8. Palatar length
9. Palatar breadth

(compiled from Rothhammer et al. 19811.

Nonmetric Traits - bone

There has been quite a debate among physical anthropologists over the validity of using nonmetric traits. In their (1984) study Rothhammer et al., found that nonmetric and metric factors appeared to be comparable and quite constant with regard to change in time. Much more work needs to be realized in this area in order to determine whether nonmetrical traits can be used instead of craniometry (Rothhammer et al. 1984:159).

It is professed that discrete traits such as the mylohyoid bridge "are genetic in nature, vary in frequency between closely related population groups, do not vary with age, show no sex difference, and are easily defined" (Sawyer et al.1978:9). Ossenberg (1974) proclaimed that there are two types of mylohyoid bridges. The most common one "extends from a few millimeters anteroinferior to the mandibular foramen to the anterior margin of the roughened region for the insertion of the mediai pterygoid muscle with the canal" (Sawyer et al. 1978:9). The less common

type of mylohyoid bridge starts higher up and is commonly discontinuous (Sawyer et al. 1978:9). The mylohyoid and foramen bridging could prove to be an effective means of distinctly identifying population groups, if used in conjunction with other similar types of discrete traits (Sawyer et al. 1990:179). In this study of Pre-Columbian Chileans, females were found to have a higher rate of jugular foramen at a rate of 18.2%, males at a rate of 10.91% whereas the overall occurrence was 14.94% (Sawyer et al. 1990:179) (Table 2).

Table 2. Sex and size differences in the incidence of jugular foramen bridging in a population of Pre-Columbian Chileans.

Sex[1]	(n)	Present	Absent
Male	110	12	10.91
Female	131	24	18.32
Total	241	36	14.94
Side[2]			
Right	241	25	10.37
left	241	16	6.64

[1] 'X' - 2.686. df - 1. P - 0.1078 (N.S.).
[2] 'X' - 2.169. df - 1. P - 0.1417 (N.S.).

(Compiled from Sawyer et al. 1990).

The jugular foramen showed differences between the sexes and sides; the left side being more prominent (Sawyer et al. 1990:180) (Table 3). The mylohyoid groove bridging showed a frequency rate of 4.09% and no difference was found between the sexes (Sawyer et al. 1990:180).

The torus palatinus and torus mandibulares are other discrete traits that can aid in the identifying of population groups. Both are believed to be hereditary in nature or to have certain hereditary proclivities. Because of their high frequency variation, these traits along with the before mentioned can help identify different population groups (Sawyer et al. 1979:525).

Table 3. Matrix of association between sides in the occurrence of jugular foramen bridging.

	RIGHT:		
LEFT:	Present	Absent	Total
Present	5	11	16
Absent	20	205	225
Total	25	216	241

'X' - 8.034, df = 1, P - 0.0048.

Compiled from Sawyer et al. 1990).

Nonmetric Traits - Dentition

The talon cusp or t-shaped incisor is an uncommon anomaly which appears in the primary and permanent dentition. This anomaly is reported to have appeared in individuals with a cleft lip and/or cleft palate. The talon cusp poses problems of dental caries control, occlusal accommodation, and in terms of esthetics (Sawyer et al. 1976a:65).

The shovel-shaped incisor is a morphological variation used in the assessment of population proclivities and "as an aid in tracing population migrations" (Sawyer et al. 1976b:54). The frequency of the shovel-shaped incisor is greater among the maxillary incisor than with mandibular incisors (Sawyer et af. 1976b:54). The frequency of this anomaly varies tremendously from one population to another (Table 5). "In modern man, marked shovelling usually suggests Mongoloid affinities" (Sawyer et af. 1976b:55). Also, the degree of shovelling is much greater amid Mongoloid groups than with Caucasoid races. Hanihara (1963) has indicated that the proportion of shovelling is more often in permanent dentition than in the deciduous dentition. Shovelling has shown a certain degree of sex differentiation, the highest occurrence being among females (Hrdlicka 1920). Table 4 displays the frequency of shovelling for numerous populations.

Table 4. Percentage Frequency of Shovel-Shaped Incisors in selected populations - permanent teeth/pooled sexes

Population	n	Frequency
Aleut (11)	75	100.0
Aleut (12)	70	100.0
Polynesian	96	76.0
Mapuche Indian (11)	376	56.9
Mapuche Indian (12)	376	93.6
Chileans	689	45.7
Pewenche Indians	73	95.3
Early Am. Indian	17	63.0
Mongolian	24	100.0
Eskimo	40	100.0
American White (a)	2000	68.5
American White (b)	642	55.0
Pima Indian	226	100.0
Diguitas Indian	60	80.3

(Compiled from Sawyer et aI. 1976).

The Carabelli's cusp is a genetically determined anomaly also used in racial classifications. It is most common among Caucasoids. Another inherited anomaly is the protostylid. Protostylid is most common among mongoloid races. If one or more of these anomalies are paired they may prove to be a useful means of determining racial groups (Sawyer et al. 1976b:55).

There have not been many studies on tooth size on South American Indians. One such study by Harris and Nweeia (1980) suggests that there is little sexual dimorphism in tooth size "and that this probably results from a diminution in mean male crown diameters rather than an increase in female tooth size" (Harris and Nweeia 1980:81). Studies have shown that tooth size is less useful for purposes of detecting morphological differences between population groups than say tooth shape (Harris and Nweeia 1980:81).

Anthropometry

The amount of data available for living South American Indians is considerably small. Marcellino et al. (1978) compared six tribes using the Mahalanobis'

Table 5. Percentage Distribution and Frequency of Protostylid in deciduous (d) and permanent (p) molar teeth of selected populations.

	Incidence(%)			
Population	Dm2	Pm1	Pm2	Pm3
American White(a)	15.0**	6.0**	25.5**	0.0**
Pima Indian	60.0**	31.5**	20.0**	20.0**
Cont. Peruvian Indian	44.5	68.2	44.8	16.7
Pre-Columbian Peruvian	69.2***	66.5***	51.7***	23.7***
American White (b)	13.0			
Japanese	44.7			
Negro	17.0			

** Percentage for m8Je Population only.
*** Baed on the number of molar. aVlil.ble for Itudy.

(Compiled from Sawyer et al. 19761.

morphological distances. In the results, "males and females from the same village are essentially similar in shape, the main difference in this component occurring between villages (and tribes)" (Marcellino et al. 1978:72). Johnston et al. (1971), carried out a study of the Cashinahua Indians of Peru. They took measurements of skinfolds, endosteal and periosteal breadths of the second metacarpals and various other anthropometric measurements. The analysis of these Indians demonstrated that they are short and heavy and are morphologically similar to other populations (Johnston et al. 1971:409). Not much work has been done to analyze modern populations, which is a primary weakness in this area.

Paleopathology - Cranial Deformation

The cultural trait of intentional cranial deformation was very prominent among South American Pre-Columbian peoples. There are several forms of cranial deformations,

among them tabular erecta, tabular obliqua, annular **I,** and cuneiform (Munizaga 1976:687). Munizaga (1974) carried out a study where 54 skulls showed intentional skull deformation of a circular variety. These were formed by using very thin threads and wrapping it around the skull to form a type of turban (Munizaga 1974:330). "The cuneiform is marked by flattening of the entire occiput (not just the upper, membraneous-derived bone) without evidence of counter pressure in front" (Munizaga 1976:687). The intensity of the deformation varies in severity, from slight to very distinct (Munizaga 1974:330). This form of cranial deformation was present on the northern coast of Chile as early as 3400 B.P.; whereas the tabular erecta variety was found about the same time on the coast of Ecuador and on the northern and central coasts of Peru (Munizaga 1974:333). In order to distinguish the tabular erecta from the tabular obliqua there are a number of criteria to be followed (Dembo and Imbelloni N.D.). Such criteria include the nature of the occipital bone, its curvature, angle, and the severity of the pressure (Dembo and Imbelloni N.D.). Ecuador has sustained some of the earliest instances of cranial deformation. Ecuador seems to be a core geographical area for the diffusion of this cultural trait (Munizaga 1976:690). Because cranial deformations are cultural traits they have chronologie as well as geographical disseminations (Stewart 1963:45). These deformations were usually inflicted on young infants while their skulls were still soft. Each variety of deformation has its own specific type of apparatus (Dembo and Imbelloni N.D.). Countless instruments were used to mold the heads of the young. Most techniques applied the use of boards and tablets. The use of bands, was also common practice such as in the cuneiform type; although some techniques did involve the use of both boards and bands (Munizaga 1976:690). The Quebrada de Humahuaca used an arrangement of free boards applied to the forehead and the occiput (Imbelloni 1963:54). "This consisted of two boards, ...the smaller was

placed on the forehead, the larger on the occiput, ...the two boards were then drawn toward each other by tightening the slender strands of wool which passed around them" (Imbelloni 1963:54). The annular type of deformation was realized by winding belts and bandages around the head in the form of a coif.

Paleopathology - Trephination

Trephining is a surgical operation on the skull practiced by Pre-Columbian populations, and which was conducted on living people. This form of surgical procedure is most commonly found in Bolivia and Peru, although in some instances it has been seen in parts of Argentina and Northern Chile (Stewart 1963a:45). There are three techniques known to this form of surgical procedure, cutting or sawing, scraping, and drilling (Stewart 1963a:45). "Cutting was done in both straight and curved lines. Straight-line cutting, perhaps better designated sawing, produced angular openings, usually square or rectangular, with the cuts extending into the bone beyond the opening" (Stewart 1963a:46). Curved cuts left a tidier rounded opening. The process by the curved method is thought to have been **slŏw.** Scraping was also a slow procedure, that left a damaged area larger than the final aperture (Stewart 1963a:46). lastly, drilling seems to have been rarely used and then only for small openings (Stewart 1963a:46). These procedures were performed using quartz and obsidian tools. The survival rate for these operations is quite good, found to be approximately 60% (Stewart 1963a:46). The motive for trephining is considered to be therapeutic in nature, suchlike the relief of headaches caused by concussions (Stewart 1963a:46). "The defect in the skull is said to have been covered in some instances by a disk of shell, metal or other material. These disks, if recovered in situ, rarely have been described" (Stewart

1963a:46). One such example is of a Paracas individual with the trephined opening covered by an irregular sheet of gold (Stewart 1943b:53).

Paleopathology - Dental Mutilations

Chipping of the teeth was not practiced until historic times, being introduced by the negro slaves. Mutilation by filing and inlay was practiced in Ecuador, Bolivia, Peru, and Chile. Inlay and filing was indigenous to South America. The material for inlay work was gold, usually in circular form (Stewart 1963a:47). It is unknown how the inlay work was performed, but Dembo and Imbelloni (N.D.) believe it was by way of a stone drill, rotated over sand. Tooth extraction was also a common practice among certain tribes of South America. Extraction is achieved by means of hitting a slab of wood placed on the tooth to be removed with a stone (Dembo and Imbelloni N.D.). Another customary practice is that of fracturing the tooth with a hammer, the head of which was made from various materials (Dembo and Imbelloni N.D.).

Dental mutilation was practiced for several reasons. One such popular reason is for mere beautification and/or ornamentation. Some tribes used dental mutilation as a form of initiation rite, such as coming of age. Another purpose may be to express rank, to display one's status of nobility (Dembo and Imbelloni N.D.).

Pathology-Infectious disease

The presence of chronic infectious diseases in the new world appears to be an uncommon occurrence. The most common and easiest of these to identify was tuberculosis (Stewart 1963b:50). "The identification of tuberculosis is somewhat more definite than syphilis because of the tendency of the former to

localize in the spinal column and produce kyphosis, the condition known as hunchback" (Stewart 1963b:50).

Arthritis was found to be a common pathological condition among the ancient Peruvians. There are various forms of arthritis, some of the forms encountered are lipping, arthritis deformans or hyperthropic arthritis (Stewart 1963b:50). Dental disease is thought to be a contributing factor to arthritis (Stewart 1963b:51). The condition termed lipping, is marked by growth of bone along the edge of a joint (Stewart 1963b:50). Arthritis deformans or hyperthropic arthritis is an ailment characterized by "erosions of the joint surface together with polishing or eburnation" (Stewart 1963b:50). In the collection examined by Hrdlicka (1914) arthritis was confined to the joints. The incidence of arthritis of the hip joint was quite high. In these cases the head of the femur was deformed into a shape termed 'mushroom head', or 'capis penis' (Stewart 1963b:51).

In a more recent study by El Najjar (1979), although these conditions were rare, his findings show that treponematosis and tuberculosis were endemic to the New World. Some syphilitic bones have come from the skeletal remains-of Paracas; remains show some of the characteristic lesions associated with syphilis (Stewart 1943a:55).

The child's skeleton retrieved from the Alto Salaverry site, is the first example of "a pitting of the orbital roof associated with anemia" (Trinkaus 1977:25). The orbital roof discloses the condition known as cribra orbitalia, it is most prominent in the left orbit (Trinkaus 1977:25). "This condition had been recognized...as a manifestation of general osteoporosis of the cranium known as porotic hyperostosis" (Trinkaus 1977:25). It believed that the conditions of cribra orbitalia and porotic hyperostosis in Pre-Columbian individuals is the direct result of iron deficiency anemia (Trinkaus 1977:27). The evidence of hookworm infestation

could also be the cause of such ailments, since the loss of blood caused by this parasite can lead to severe anemia (Trinkaus 1977:27).

In Ubelaker (1979) "analysis of the Aylan burials revealed unusual alterations on many of the metatarsals and phalanges...metatarsals display facets and/or small bony extensions on the superior surface of the distal end" (Ubelaker 1979:679). These alterations occur with the same frequency on both the left and right feet (Ubelaker 1979:679). Ubelaker (1979) concluded that these alterations were the cause of stress brought about by constant kneeling.

Exostosis and bone tumors can occur in any part of the skeleton and their cause is not known (Stewart 1963b:51). The most common area to be affected is the auditory meatus, termed ear exostosis (Stewart 1963b:51). The frequency of occurrence is much higher in males than in females (Stewart 1963b:51). Another type of exostosis with a functional use is the "third trochanter" of the femur (Stewart 1963b:51). This condition is most common in females. A less frequently occurring hyperostosis develops "on the inner side of the lower jaw in the region of the premolars and molars" (Stewart 1963b:51).

A contributing factor to the cause of arthritis is believed to be dental disease. The correlation of these conditions have not yet been well established nor documented in South America (Stewart 1963b:51). The majority of the studies carried out on the teeth have been on dental caries, the chief cause of antemortem tooth loss (Stewart 1963b:51). "Cavities first appeared in the developmental pits and fissures on the crowns of the molars and then on the approximo-cervical surfaces of all teeth" (Stewart 1963b:51).

Discussion

Much work has been done with regards to archeological material. It is evident that the importance of such finds lies tracing the microevolutionary processes of prehistoric populations. Such studies can aid in detecting the morphology and population variances among the living South American populate.

More work needs to be done not only in the area of anthropometry of South American Indians, but also in dentition, paleopathology, and pathology. "In view of the widely differing environments in South America and the different diets of the native peoples that this entails, a broad study of the dental conditions here in prehistoric times would contribute to the knowledge of their etiology" (Stewart 1963b:51).

Craniometric measurements have been the primary way of assessing skeletal material in South America. The evaluation of non-cranial skeletal material has been for the most part completely ignored (Stewart and Newman 1963:19). The reasons for this prejudice is unknown. Other means of skeletal assessment need to be looked into. Another area of heated debate is in the validity of using discrete traits. More research needs to be carried out in order to establish the validity of using nonmetric traits. In the future we might find that craniometric and discrete traits can be paired to be used simultaneously. The use of both craniometric and nonmetric traits may prove to be a more accurate means for determining morphological variations of different populations.

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