

**EXTRA-CONTINENTAL MORPHOLOGICAL AFFINITIES
OF PALLI AIKE, SOUTHERN CHILE**

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SUMMARY

Morphological comparative studies conducted over the last ten years have demonstrated that the first Americans cannot be described as Mongoloids. In fact the cranial morphology of the Paleoindian skeletons show a clear tendency to cluster with Australians and Africans instead of with Asians and modern Amerindians in different multivariate analyses. This has been demonstrated for both South and North America. Regarding South America, most of the studies conducted up to the present have concentrated on skeletal remains from central Brazil, a

tropical area. In this paper, we add to the current research on Paleoindian morphology by analyzing an individual of late Paleoindian age from the site of Palli Aike, Tierra del Fuego, an area of South America characterized by very low temperatures. The results show that the early Fuegians also did not present any morphological affinity with Mongoloids. Similar to the Paleoindian skeletons from Central Brazil and Sabana de Bogotá, in Colombia, the Palli Aike specimen shows a marked affinity with Africans and Australians.

Comparative analyses of the cranial morphology of North and South American skeletons

that date to the beginning of the Holocene, carried out over the last ten years, have led re-

searchers to question the currently accepted scenario concerning the occupation of the

Americas, namely the Three Migration Model (Turner 1983, Greenberg *et al.*, 1986).

KEY WORDS / Multivariate analysis / Cranial morphology / Paleoindian / Tierra del Fuego /

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RESUMEN

Los estudios morfológicos comparativos realizados en los últimos 10 años han demostrado que los primeros americanos no pueden ser descritos como mongoloides. La morfología craneana de los esqueletos paleoindios muestran una clara tendencia, probada en diferentes estudios multivariados, agrupados como australianos y africanos en lugar de considerarlos como asiáticos y amerindios actuales. Esto ha sido demostrado tanto para Sudamérica como para Norteamérica. En Sudamérica, la mayoría de los estudios realizados hasta el presente se han centrado en restos esqueléticos del Brasil cen-

tral, que es un área eminentemente tropical. Con el presente estudio se aporta a la investigación actual sobre morfología paleoindia, el análisis de un individuo paleoindio tardío del sitio Palli-Aike, Tierra del Fuego, un área Sudamericana caracterizada por poseer temperaturas muy bajas. Los resultados muestran que los fueguinos tempranos tampoco presentan afinidad morfológica con los mongoloides. Conjuntamente con los esqueletos de Brasil central y de la sabana de Bogotá (Colombia), el espécimen de Palli-Aike muestra una marcada afinidad con africanos y australianos.

RESUMO

Vários estudos sobre morfologia comparativa efetuados nos últimos 10 anos vêm demonstrando que os primeiros Americanos não podem ser vistos como Mongoloides. Na verdade, a morfologia craniana de esqueletos paleo-indios mostra uma clara tendência em agrupá-los com Australianos e Africanos, e não com Asiáticos e Ameríndios atuais, como esperado. Este fato já foi demonstrado tanto para a América do Sul quanto para a América do Norte. Com relação à América do Sul, a maioria dos estudos conduzidos até agora tem se concentrado sobre remanescentes ósseos humanos do Brasil Central, uma área eminentemente tropical. Neste artigo, nós adicionamos à

pesquisa correntemente em curso sobre a morfologia dos primeiros Americanos, os remanescentes ósseos humanos exumados no sítio de Palli Aike, Terra do Fogo, uma área da América do Sul caracterizada por temperaturas muito baixas. O espécime exumado de Palli Aike apresenta antiguidade paleoindia tardia. Os resultados mostram que os primeiros fueguinos também não apresentavam afinidades morfológicas com os Mongolóides. Assim como os paleoíndios do Brasil Central e da Sabana de Bogotá, na Colômbia, o espécime de Palli Aike mostra uma clara afinidade morfológica com Africanos e Australianos.

Neves and Pucciarelli (1989) were the first to call attention to the fact that when the cranial morphology of the Paleoindians and their direct descendants is compared with world-wide cranial variation, they have a tendency to cluster with South Pacific populations, and not with North Asians and modern Amerindians, as would be expected under the Three Migration Model.

The initial idea of Neves and Pucciarelli has been significantly strengthened in the years that followed the first publication. Further studies with additional skeletal material from South America as well as integrating new Late Pleistocene fossil material from the Old World have not only confirmed their first impression, but also have revealed that the morphological relationships of the first Americans included both modern populations and fossil hominids from Australia and Africa (Neves and Pucciarelli, 1990, 1991; Neves *et al.*, 1993, 1996b). Steele and Powell (1992) and Powell and Steele (1992) also presented

TABLE I
CRANIOMETRIC TRAITS USED IN THE ANALYSIS
(VARIABLES DEFINED IN HOWELLS, 1973)

Variable name	Abbrev.	Palli Aike value
Glabella-occipital length	GOL	186
Nasio-occipital length	NOL	183
Maximum cranial breadth	XCB	140
Maximum frontal breadth	XFB	122
Biauricular breadth	AUB	127
Biasterionic breadth	ASB	112
Mastoid length	MDH	28
Mastoid width	MDB	16
Interorbital breadth	DKB	20
Supraorbital projection	SOS	6
Glabella projection	GLS	1
Nasion-bregma chord	FRC	112
Nasion-bregma subtense	FRS	29
Nasion subtense fraction	FRF	47
Bregma-lambda chord	PAC	122
Bregma-lambda subtense	PAS	29
Bregma subtense fraction	PAF	69
Lambda-opisthion chord	OCC	93
Lambda-opisthion subtense	OCS	31
Lambda subtense fraction	OCF	40
Vertex radius	VRR	125
Nasion radius	NAR	99
Dacryon radius	DKR	93

some evidence showing that the few known North American Paleoindian skulls could

not be said to be of Mongoloid nature. Although they initially related the Paleoindian

morphology with those of Europeans and South Asians, they later advocated a relationship with Australians as soon as size was corrected in their analysis (Steele and Powell, 1993, 1994).

In summary, by the middle of this decade, it was already well established through comparative cranial morphological studies that the first people to colonize North and South America could not be referred to as Mongoloids, since they show no particular resemblance either with modern North Asians or Amerindians. In the second part of the decade, one of us (WAN) led several new studies aiming at understanding the cranial morphological variation in South America through time. Munford *et al.* (1995) and Neves *et al.* (1996a) demonstrated, as a result of this effort, that when the cranial morphology of the South American prehistoric populations is analyzed through time, it becomes clear that the morphology changed abruptly in the subcontinent between Paleoindian and Archaic times. This allowed the au-

thors to conclude that in South America a typical Mongoloid morphology replaced a non-Mongoloid cranial pattern between 9 and 8,000 years B.P. Consequently, at least as seen from South America, the cranial morphological variability through time suggests that two different migrations entered the subcontinent. This information allowed Neves and co-workers to suggest a Four Migration Model to explain the settlement of the Americas (Neves *et al.*, 1996a, 1997, 1998).

In addition, recent studies investigating the dental variation of North and South American archaeological human remains have also questioned the Three Migration Model. Powell (1995) has demonstrated that North American Paleoindian and Ar-

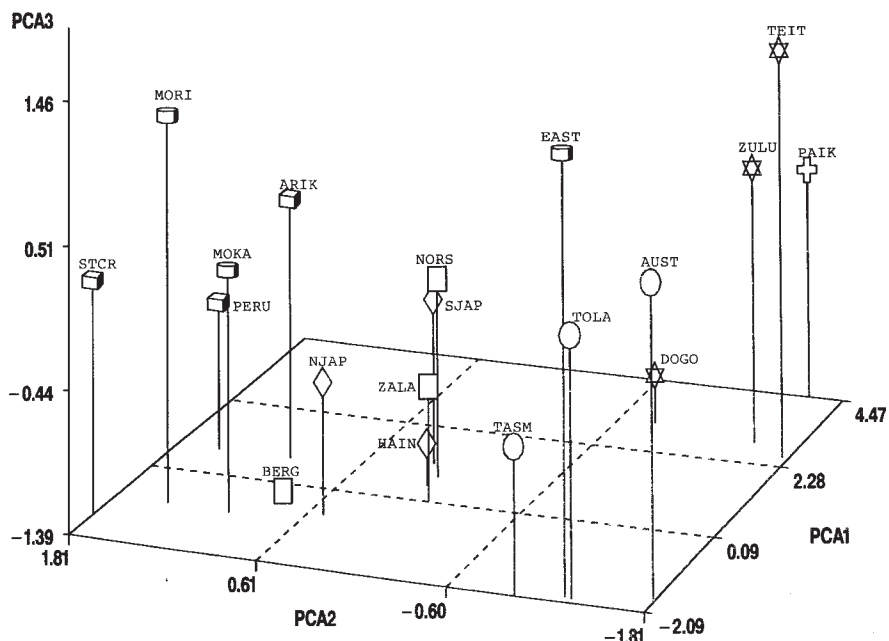


Figure 1 - Three dimensional graph based on the scores of the first three Principal Components.

TABLE II
MAIN PARAMETERS OF THE FIRST THREE PRINCIPAL COMPONENTS GENERATED

Principal Component	Eigenvalue	Proportion explained	Cumulative proportion explained
PC1	5.60361	0.243635	0.24364
PC2	2.93421	0.127574	0.37121
PC3	2.35427	0.102360	0.47357

chaic skeletons cannot be classified as Sinodont in the scheme proposed by Turner (1983). When a classification was forced they aligned with sundadonts instead. In a recent work, Powell and Neves (1998) extended the same conclusions to South American Paleoindians. Haydenblit (1996) showed that the same phenomenon can be identified among late Mayans of Central America. Sutter (1997) analyzing the dental variation of early and late archaic populations of Southern Peru and Northern Chile, under the same methodological framework as Turner (1983), concluded that both dental patterns, sundadonty and sin-

odonty, can be found in the region, with the latter replacing the former. For this reason, Sutter has proposed that at least two different populations colonized South America in ancient times, a point that was central in the formulation of the Four Migration Model proposed by Neves and co-workers (Munford *et al.*, 1995; Neves *et al.*, 1996a, 1997).

In this paper we analyze the extra-continental morphological affinities of a late Paleoindian skull recovered from the site of Palli Aike, Southern Chile, in the beginning of the century. The analysis is part of an effort to verify if Paleoindians inhabit-

TABLE III
CORRELATION BETWEEN THE ORIGINAL CRANIOMETRIC VARIABLES AND THE THREE PRINCIPAL COMPONENTS GENERATED.

Variable	PC1	PC2	PC3
GOL	0.283367	-0.166822	0.317956
NOL	0.323990	-0.110027	0.295279
XCB	0.253486	0.314044	-0.220026
XFB	0.288166	0.146173	-0.263313
AUB	0.182016	0.324061	-0.054764
ASB	0.200841	0.266705	-0.052176
MDH	0.015686	0.149304	-0.004763
MDB	-0.130905	0.168592	0.121096
DKB	0.130893	-0.194555	0.025023
SOS	-0.179160	-0.227199	0.031228
GLS	-0.343567	0.003565	0.036801
FRC	0.285987	0.025041	-0.008808
FRS	0.196378	-0.181829	-0.145485
FRF	0.049303	0.088440	-0.107541
PAC	0.229559	-0.346052	-0.163557
PAS	0.100566	-0.242331	-0.358425
PAF	0.196034	-0.256418	-0.239635
OCC	0.189564	0.294943	0.188994
OCS	-0.001527	0.154294	0.294065
OCF	0.026586	0.256507	0.091958
VRR	0.277403	0.107353	-0.096044
NAR	0.188378	-0.167642	0.381579
DKR	0.190300	-0.147541	0.373733

ing areas of South America other than Central Brazil also display a non-Mongoloid cra-

nial morphology. It is possible to argue that since most of the research in South

America has concentrated on one tropical area, any morphological similarities between Paleoindians and Africans and Australians would be the result of convergent evolution from similar environments. Since the site of Palli Aike is located in an area with a very cold climate, results showing the same pattern of extra-continental association would add strength to our previous findings.

Material and Methods

The skull analyzed in this paper refers to a skeleton uncovered in the rock-shelter of Palli Aike, Magellan Strait, Tierra del Fuego, southern Chile, during excavations carried out in the region by Junius Bird, from 1932 to 1937 (Bird, 1938, 1963, 1965). This material is housed at the American Museum of Natural History, New York, under the catalogue number 99.1/773. The skeleton, although very gracile, belonged to an adult male as emphasized by Munizaga (1976) and was partially burned.

In accordance with the original description of the site (Bird, 1938), the rock floor of the cave was eight and a half feet below the surface. At a depth of five feet there was a layer of volcanic ash, on which there were three cremation burials associated with scattered broken and burnt bones of American horse and ground sloth, and with occupational debris, including stone and bone tools. A date of 8639 \pm 450 BP based on burnt fragments of extinct megafauna bones was obtained by Junius Bird many years after the excavations (Libby, 1966). For this reason, Palli Aike has been treated in the South American literature as a late Paleoindian site (Schobinger, 1969; Dillehay *et al.*, 1992).

Recent trials by one of us (WAN) to precisely date the specimen directly by Accelerator Mass Spectrometry (AMS) were unproductive,

since no collagen for dating was found in the skeleton. However, free carbon molecules found during the pretreatment of the sample (acid washes) were dated and generated an age of 7,830 \pm 60 BP (Beta-099066). This date must, however, be taken as a minimum age, since these free carbon molecules can be partially derived from contamination by younger organic material (Darden Hood, personal communication, 1996). Taking into account the original date generated from associated megafaunal fragments and the recent one generated from human bones, the skeleton will be assumed to be of late Paleoindian origin.

The skull was measured by one of us (WAN) in 1996, using the dimensions and criteria proposed by Howells (1973, 1989). Since the face and the base is missing, the measurement of the specimen resulted in only 23 dimensions of the neurocranium. The craniometric variables obtained can be seen in Table I.

The Palli Aike specimen was compared with modern world-wide cranial morphological variation using 18 populations from the data bank of Howells (1973, 1989) as comparative samples. The comparison was carried out by means of a Principal Components Analysis, with no rotation performed. The data were size corrected using a Q mode method of standardization (Darroch and Mosimann, 1985) before performing the multivariate analysis.

Results

Table II presents the main parameters of the first three Principal Components (PCs) generated. As can be seen, they summarize 47.0% of the original information.

Table III presents the correlation between the original craniometric variables and the first three PCs. The first PC is primarily influenced by the following variables:

TABLE IV
PRINCIPAL COMPONENTS SCORES

Sample	PC1	PC2	PC3
Norse	0.8182418	0.0865822	-0.0495141
Zalavar	0.1349597	-0.0030996	-0.6283768
Berg	-0.1289298	0.8914544	-1.3891983
Teita	2.5658969	-1.7656264	1.3656150
Dogon	3.1528454	-0.8370720	-1.0625923
Zulu	2.9140947	-1.5210696	0.4863483
Australia	-1.8148584	-1.8059508	0.6591342
Tasmania	-2.0919153	-1.0263157	-0.4359064
Tolai	-1.9660661	-1.3424756	0.2949693
Mokapu	-0.9110399	1.0671675	0.2231219
Easter Island	-1.9423124	-1.2974688	1.4560694
Moriore	-0.8599717	1.4758189	1.1893340
Arikara	0.8322421	1.0632592	0.3693393
Santa Cruz	-1.4629038	1.8120201	0.1645792
Peru	0.7992872	1.5414532	-0.3849418
North Japan	-0.6334794	0.5067671	-0.5091788
South Japan	1.1792059	0.1928706	-0.2715741
Hainan	0.5443305	0.0987506	-1.1080047
Palli Aike	4.4656881	-1.5852569	0.1961041

Glabella-occipital length (GOL), Nasio-occipital length (NOL), Maximum frontal breadth (XFB), Glabella projection (GLS), Nasion-bregma chord (FRC), and Vertex radius (VRR). Put in a different way, the first PC seems to express mainly the longitudinal profile of the neurocranium and its vertical projection. The second PC is primarily influenced by Maximum cranial breadth (XCB), Biauricular breadth (AUB), Biasterionic breadth (ASB), Bregma-lambda chord (PAC), and Lambda-opisthion chord (OCC). Although a morphological interpretation for this PC is more complex, it can be said to summarize mainly the information of lateral expansion of the neurocranium, and the relationship between the occipital chord and the parietal chord. The third PC is primarily influenced by Glabella-occipital length (GOL), Nasio-occipital length (NOL), Bregma-lambda subtense (PAS), Lambda-opisthion subtense (OCS), Nasion radius (NAR), and Dacryon radius (DKR). This PC seems to express at the same time the sagittal profile of the neurocranium,

in as much as PC1 does, and the projection of the upper face.

Table IV presents the principal component scores for the 19 samples included in the analysis (18 samples from Howells, 1989, plus Palli Aike). These scores were used to build the three dimensional graph of Figure 1. As can be seen, the Palli Aike specimen shows a clear affinity with Africans if Principal Component 1 and 2 are taken into account together, and with Africans and Australians if Principal Component 2 only is observed. In this second case, Easter Island, a Polynesian sample, also approaches the cluster with Palli Aike. Principal Component 3 does not allow for any simple visualization of cluster formation. The association between Palli Aike and Africans and Australians are derived from the fact that they all share a dolichocranic morphology, while the closest proximity to Africans is explained by the fact that Palli Aike also has a comparatively large value for frontal breadth, and a meager glabellar projection, in con-

trast to the usual Australian expression.

Discussion and conclusions

Although the results obtained in this work are based on one single skeleton, they tend to confirm the initial idea expressed in this paper that the first people to colonize the Americas were not of Mongoloid nature. In this sense our results strongly disagree with those of Munizaga (1976), who characterized both Palli Aike and Cerro Sota human skeletal remains as typical Mongoloids and with those of Turner and Bird (1981) who found their dentition to be very similar to that of late Amerindians. It is worth noting that Turner and Bird (1981) pooled together teeth from both Palli Aike and Cerro Sota, assuming both materials to be of Paleindian origin. Today we know, however, that the skeletons from Cerro Sota are dated of late archaic times (Ian Tattersall, personal communication, 1996).

Lahr (1995) has reached a conclusion similar to ours when studying the cranial morphology of modern Fuegians. She realized that the morphology of modern Indians of Tierra del Fuego could not be described as typical Mongoloid as well. Since she detected a close association between historic Fuegians and Polynesians she opted to interpret the cranial morphology of the former as generalized Mongoloid, at best. In her opinion this generalized Mongoloid morphology could be explained as a retention of characteristics of the first inhabitants of the Americas.

As far as we can draw conclusions from a single skeleton, the fact that Palli Aike aligns with Africans and Australians, instead of with Asians and modern Amerindians is significant in at least two different ways for the current debate about who were the first Americans. First, it shows that people

similar to those that inhabited the Lagoa Santa area, in central Brazil, and the area of Sabana de Bogotá, in Colombia, once had a wide distribution across South America, reaching even the southernmost region of the sub-continent. Second, but intrinsically related to the first fact, that the non-Mongoloid morphology already demonstrated to occur in tropical and subtropical areas of South America (Neves and Pucciarelli, 1989, 1991; Neves *et al.*, 1993, 1996b, 1998), can also be found in regions characterized by very cold weather. This supports the idea that the relationship of the first known Americans with Africans and Australians cannot be explained in terms of convergent evolution due to similar climatic factors alone.

As we have stressed in previous publications, based on better samples sizes, the best way to explain the similarities of the first Americans with Australians under a historical perspective is to admit that both shared a common ancestral population in mainland Asia, at the terminal Pleistocene. Our own investigations had already detected some similarities between the Australians, the first Americans and the people from Zhoukoudian Upper Cave, who lived in China around 20,000 years BP (Neves and Pucciarelli, 1991, 1998; Neves *et al.*, 1996b). Kamminga and Wright (1988) and Wright (1995) have also suggested a morphological relationship of this late Chinese material with Australo-melanesians and not with Mongoloids. The Zhoukoudian Upper Cave people could well be representatives of the ancestral population hypothesized here.

As to the similarities with Africans, the best way to explain it in terms of historical connections, is to assume that the Asian ancestral population that gave rise to the Australians and to the first Americans had its ultimate origins in the African continent, as it

is in fact the case with all modern humans (Stringer and Andrews, 1988; Stringer and McKie, 1996; Lahr, 1994, 1996), but which retained a very generalized morphology. In accordance with Lahr (1996), the Australians are in fact the contemporary aboriginal population that retained the most primitive morphology when compared to the first modern humans. As she stressed "Groups like [.....] Australo-Melanesians are all examples of relatively early diversifications without great amounts of gene flow from other groups..." (Lahr, 1996, p.335).

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