Early skeletal remains and the peopling of the Americas

Walter Alves Neves[1-2]
Diogo Meyer[1]
Héctor Mario Pucciarelli[3]

RESUMO: Nós investigamos as afinidades morfológicas das populações esqueletais mais antigas da América do Norte e do Sul, com base na variabilidade craniana mundial, através de uma Análise de Componentes Principais. Duas análises foram efetuadas, uma usando-se tamanho e forma e outra usando somente informação quanto a forma. Os resultados obtidos para as mulheres, em ambas as análises, não permitiram qualquer interpretação factível sobre as afinidades extra-continentais dos primeiros americanos. Quanto aos homens, a análise baseada em tamanho e forma mostrou que as séries arqueológicas americanas ocupam uma posição intermediária entre os grupos do Pacífico Sul e do Sul da Ásia/Europa. Quando a informação quanto a tamanho foi retirada da análise, as quatro séries esqueletais exibiram uma associação mais pronunciada com o Pacífico Sul. Esses resultados sugerem que tanto a América do Norte, quanto a do Sul foram, ambas, ocupadas por populações pré-mongoloides similares, cuja morfologia demonstra uma semelhança acentuada com aquela das populações do Pacífico Sul.

PALAVRAS-CHAVE: Paleo-indios, Análise Multivariada, Morfologia Craniana, Lagoa Santa, Tequendama.

Introduction

For a long time the analysis of the morphology of early American skeletal remains has been totally absent from the anthropological literature dealing with the peopling of the New World. Recently, independent studies carried out with South and North American material by South and North American physical anthropologists, respectively, generated unexpected results regarding the extra-continental biological affinities of the earliest known skeletons of the American continent.

Two of us in a series of contributions (Neves and Pucciarelli, 1989;1990;1991) have called attention to the fact that, when the morphology of the earliest South Americans is compared with the worldwide cranial variation, these populations show no special evidence of morphological affinities with the mongoloids, a fact also emphasized more recently by Soto-Heim (1994). Furthermore, in all analyses carried out by these authors the ancient South American series showed a strong morphological similarity with past and present South Pacific populations. This led us to suggest that the New World was first colonized by pre-Mongoloid immigrants with strong affinities with those that arrived in the South Pacific in the Late Pleistocene. The most economic hypothesis to reconcile these findings is to accept that the similarity between South America and South Pacific is due to shared ancestrality in mainland Asia, although some archaeologists have expressed the opinion that these findings could be used to sustain the hypothesis of an indepedent colonization of South America, via a Pacific route.

More recently, Steele and Powell (1992) were able to assemble together half a dozen cranial remains of probable and affirmed Paleo-Indians from North America and to carry out a comparative analysis very similar to that performed by Neves and Pucciarelli (1989), comparing the morphological similarity of this material with the

worldwide human cranial variation, by means of uni and multivariate analysis. Although Steele and Powell (1992) used much less skeletal material and a smaller number of metric traits as compared to the analyses carried out by Pucciarelli and Neves, their results closely paralleled the ones we obtained with the South American series. In summary, the earliest North American skeletons showed no affinity with Northeastern Asians or with other mongoloid groups used as control populations, which led the authors to propose that North America was first occupied by proto-Mongoloid immigrants. However, in their study, the distribution of the North American Paleo-Indians in a two dimensional graph generated by principal components analysis led them to suggest a close affinity between the earliest North Americans and Europeans to South Asians. Although the authors have presented no detailed information about the multivariate analysis they performed, reanalysis of their original data showed that no correction for size was carried out.

In this work we investigated the extra-continental biological affinities of the first known Americans, using at the same time the North and the South American series, by means of a multivariate analysis based on size and shape and shape information alone. The aim of the work is twofold: first to verify the degree of morphological similarity between the North and South American early series, and second to verify their extra-continental morphological relationships when taken together.

Material and methods

The material used in this work is primarily the same used by Steele and Powell (1992) in their multivariate analysis, which comprises 28 series of control populations in the case of males, 25 in the case of females, and one mixed series of North American Paleo-Indians consisting of skeletal material from 8 different archaeological sites. The control

populations are composed basically by those described in Howells (1973), to which the authors added three further series in the case of the males (Japanese, Chinese and Jomon). To this set of populations we added three series of South American Paleo-Indian and early archaic skeletons, as described in Pucciarelli and Neves (1989,1991).

As anthropological markers, the investigation had to be limited to the six craniometric variables used and published by Steele and Powells (1992) for their North American skulls: maximum cranial length (GOL), maximum cranial breadth (XCB), upper facial height (NPH), bizygomatic diameter (ZYB), nasal height (NLH), and nasal breadth (NLB).

Table 1 presents the mean vectors of the six variables for each of the populations studied and their respective sources in the case of males, while Table 2 provides the same information for females.

Both sets of data were submitted to a principal components analysis, using the BMDP-4M program. The initial extraction of the principal components was based on a correlation matrix. No rotation was performed. A first analysis was carried out on the raw data, after a simple R-standardization, in such a way that size and shape information were used as criteria of similarity appraisal. A second analysis was carried out on R and Q-standardized data, using in this last case the procedure suggested by Corruccini (1973), in such a way that only shape information was used as criteria for the inference of the morphological affinities among the series involved.

Results

The results obtained with the principal components analysis are summarized in Tables 3 to 6, and Figures 1 to 4. Table 3 presents the eigenvalues, percentage of the original variance explained and eigenvectors for male and female samples regarding the two first principal components when size and shape is used as anthropological marker. Table 4 presents the principal component scores derived from this

analysis, which permitted the construction of the bidimensional graph presented in Figures 1 and 2. The same information regarding the analysis based only on shape is presented in Tables 5 and 6, and Figures 3 and 4.

In the four analyses carried out, the first two principal components account for aproximately 65% of the original variance.

The observation of Figures 2 and 4, which represent the distribution of the female series along the first two principal axis, does not allow for any clear interpretation of the extra-continental relationships of the early Americans. As can be seen, the four series of South and North American Paleo-Indians are scattered in the graph, showing no consistent proximity among themselves, neither any systematic resemblance with particular geographical areas of the world. This could be explained by the fact that in the human species females show, in general, less geographic differentiation than males, as demonstrated by Howells (1973).

The distribution of male series along the first two principal axes (Figures 1 and 3) generated, however, interpretable results. The four ancient American samples show a great similarity among themselves, occupying approximately the same region in the graphs. In no case did the investigated American samples show any particular proximity either with North Asians or American Indians. When size and shape is used as taxonomical criterion, the early Americans occupy a position in the graph (Figure 1) intermediate between two clusters: one formed by South Pacific populations plus Africans, and another formed by Europeans and South Asians. But when size is removed (Figure 3), the four series tend to occupy more clearly the area of the graph dominated by South Pacific populations.

Discussion and conclusions

The results obtained in this work point to a clear biological similarity between North American and South American Paleo-Indians.

Consequently, there is no reason to believe that South America was colonized by human groups that were not represented, contemporaneously, in North America, as some archaeologists have been suggesting. This finding is totally congruent with the more accepted model, that the continent was first occupied my waves of migrants coming from North to South, Bering Strait being the most but not the only plausible point of entry.

As to their extra-continental biological relationships, the results obtained in this work, associated with those previously obtained by us and by Steele and Powell (1992), seem to leave no grounds for questioning the fact that the Americas were first colonized by pre-Mongoloids, since the first known Americans show no special morphological association with the mongoloid series used as control in any of these multivariate analyses, including the one performed here.

Based on evidence generated by this work and the one performed by Steele and Powell (1992), the precise extra-continental biological affinity of the first Americans is not a simple problem to be solved. Those authors, using size and shape information, concluded that North American Paleo-Indians show a special resemblance to the South Asians and Europeans used as controls in their analysis. A close inspection of their bi-dimensional graphs reveals, notwithstanding, that the North American Paleo-Indians occupy, indeed, an indefinite position between South Pacific, South Asian, European, and in the case of females, African populations; a pattern very similar to that obtained in the present experiment, when early South Americans are included in the analysis.

However, when size is removed, and shape is used as the sole criteria of similarity assessment, the early North and South Americans show a more marked relationship with the South Pacific groups, confirming our previous findings using more craniometric variables, but restricted to South American material.

In summary, the results obtained in this work confirm our previous opinion that the American continent was first occupied by pre-Mongoloid migrants and do not contradict our belief that these pre-Mongoloids exhibited a strong morphological similarity to those people that occupied the South Pacific. We still think that the most economic model to accomodate this picture is to assume that, both the first Americans and the first Australians left a common place in mainland Asia. As can be realized, we prefer to use the term pre-Mongoloid instead of proto-Mongoloid, because there is no evidence to support that the people that came to be the first Americans gave rise, in the Old World, to the mongoloid morphology as it is presently known.

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Notes

1 Laboratório de Estudos Evolutivos Humanos. Departamento de Biologia, Instituto de Biociências, Universidade de São Paulo, C.P. 11461, CEP 05422-970, São Paulo, SP, Brasil.

2 Pesquisador do CNPq

3 Departamiento Cientifico de Antropologia, Museo de La Plata, La Plata, Argentina.

Table 1 - Male means for selected craniometric dimensions in the populations used in the work.

Population	Source	Cranial Length	Cranial Width	Bizygomatic Breadth	UpperFacial Height	Nasal Height	Nasal Breadth
Lagoa Santa Composite(LASC)	Neves & Pucciarelli(1989)	185.50	132.80	140.50	62.00	51.00	24.00
Lagoa Santa Sumidouro(LASS)	Neves & Pucciarelli(1989)	188.10	132.30	137.46**	64.00	48.50	23.80
Tequendama(TEQU)	Neves & Pucciarelli(1989)	186.60	128.40	137.00	68.80	50.00	24.80
North Amer.Paleo-Indian(NAPI)	Steele & Powell(1992)	188.67	139.67	137.50	66.00	51.00	25.33
Norse(NORS)	Howells(1973)*	188.47	141.87	134.44	68.93	51.96	25.42
Berg(BERG)	Howells(1973)*	180.32	147.61	135.55	67.89	51.71	25.46
Zalavar(ZALA)	Howells(1973)*	185.22	141.39	133.06	68.50	51.41	25.37
Georgians(GEOR)	Abdushelishvili(1960)*	175.50	150.54	135.44	70.59	52.71	24.57
Armenians(ARME)	Abdushelishvili(1960)*	172.44	144.23	133.27	73.50	54.11	25.41
Egypt(EGYP)	Howells(1973)*	185.62	139.22	128.83	68.43	51.74	24.83
Teita(TEIT)	Howells(1973)*	183.88	129.85	131.00	66.00	50.09	27.91
Dogon(DOGO)	Howells(1973)*	177.85	137.29	129.56	64.85	47.83	28.35
Zulu(ZULU)	Howells(1973)*	185.13	134.11	129.94	67.33	50.00	28.65
Tolai(TOLA)	Howells(1973)*	183.53	130.36	136.00	66.07	48.44	27.82
Mokapu(MOKA)	Howells(1973)*	186.31	143.72	138.82	68.61	53.31	27.39
South Australian(SAUS)	Howells(1973)*	190.31	131.94	136.77	64.77	49.69	27.88
Tasmanian(TASM)	Howells(1973)*	185.29	138.18	135.73	62.41	48.70	28.86
Upper Cave(UPCA)	Howells(1973)*	206.00	144.00	143.00	76.00	58.00	33.00
Chinese(CHIN)	Black(1928)*	178.50	138.20	132.70	75.30	55.30	25.00
Minatogawa(MINA)	Suzuki(1982)*	182.00	148.00	144.00	63.00	49.00	26.00
Jomon(JOMO)	Suzuki(1969)*	181.90	144.10	144.60	66.00	49.60	27.10
Japanese(JAPA)	Morita(1950)*	178.90	140.30	132.90	70.70	52.00	25.00
Buriat(BURI)	Howells(1973)*	181.83	154.96	144.43	74.50	56.89	28.48
Chuckchi(CHUC)	Hrdlicka(1944)*	185.70	142.70	142.50	79.60	55.10	24.40
Ostiak(OSTI)	Hrdlicka(1944)*	183.10	142.80	141.10	75.70	54.00	25.70
Pre-Aleut(PRAL)	Hrdlicka(1944)*	186.90	142.60	144.10	76.40	52.80	25.60
Aleut(ALEU)	Hrdlicka(1944)*	180.40	150.80	144.20	74.30	51.60	25.40
Eskimo(ESKI)	Howells(1973)*	188.30	133.94	139.59	71.70	54.11	23.68
Northwest US coast(NUSC)	Hrdlicka(1944)*	177.40	144.00	142.80	76.00	51.90	24.50
Pecos Pueblo(PECO)	Hooten(1930)*	175.74	137.84	138.56	72.85	50.96	25.80
Arikara(ARIK)	Howells(1973)*	179.48	141.55	140.88	71.69	54.45	27.09
Peru(PERU)	Howells(1973)*	177.96	137.94	134.93	67.78	50.34	25.24

*Apud Steele and Powell(1992)
**Missing value replaced by the mean value of the variable calculated based on all other samples.

Table 2 - Female means for selected craniometric dimensions in the populations used in the work.

Population	Source	Cranial Length	Cranial Width	Bizygomatic Breadth	Upper Facial Height	Nasal Height	Nasal Breadth
Lagoa Santa Composite(LASC)	Neves & Pucciarelli(1989)	180.10	126.60	120.20	55.80	45.50	23.40
Lagoa Santa Sumidouro(LASS)	Neves & Pucciarelli(1989)	176.80	129.90	127.70**	63.00	42.50	25.00
Tequendama(TEQU)	Neves & Pucciarelli(1989)	177.70	129.30	127.70**	65.00	51.70	23.70
North Amer.Paleo-Indian(NAPI)	Steele & Powell(1992)	176.00	138.00	127.00	62.00	47.00	21.00
Norse(NORS)	Howells(1973)*	179.98	136.29	124.44	64.25	49.16	24.18
Berg(BERG)	Howells(1973)*	170.53	140.36	126.38	63.49	48.23	24.89
Zalavar(ZALA)	Howells(1973)*	176.44	136.89	125.44	63.18	48.49	24.67
Georgians(GEOR)	Abdushelishvili(1960)*	167.81	139.62	124.93	64.28	48.41	23.68
Armenians(ARME)	Abdushelishvili(1960)*	166.19	140.92	124.30	69.06	51.02	24.00
Egypt(EGYP)	Howells(1973)*	175.58	135.57	120.06	64.06	48.96	24.02
Teita(TEIT)	Howells(1973)*	174.61	126.37	124.14	60.98	46.43	27.18
Dogon(DOGO)	Howells(1973)*	169.83	132.21	121.09	61.43	46.09	27.70
Zulu(ZULU)	Howells(1973)*	179.38	131.91	122.89	63.40	47.34	27.98
Tolai(TOLA)	Howells(1973)*	174.74	128.11	126.40	62.80	46.65	26.67
Mokapu(MOKA)	Howells(1973)*	175.39	138.67	126.88	63.75	49.39	26.02
South Australian(SAUS)	Howells(1973)*	181.10	127.51	125.78	61.14	46.51	26.24
Tasmanian(TASM)	Howells(1973)*	177.90	133.02	125.62	58.36	45.36	27.64
Upper Cave(UPCA)	Howells(1973)*	190.00	133.50	134.00	68.75	48.75	25.75
Minatogawa(MINA)	Suzuki(1982)*	171.00	136.00	136.00	58.00	46.00	24.00
Buriat(BURI)	Howells(1973*	171.82	148.42	134.45	69.45	53.42	26.82
Chuckchi(CHUC)	Hrdlicka(1944)*	177.50	136.80	132.00	73.90	51.00	23.80
Ostiak(OSTI)	Hrdlicka(1944)*	174.10	139.60	131.10	69.90	50.60	24.90
Pre-Aleut(PRAL)	Hrdlicka(1944)*	178.80	138.20	133.50	71.40	49.50	24.40
Aleut(ALEU)	Hrdlicka(1944)*	171.90	144.20	133.80	70.20	49.20	24.20
Eskimo(ESKI)	Howells(1973)*	180.81	131.02	130.17	67.06	50.39	23.31
Northwest US coast(NUSC)	Hrdlicka(1944)*	170.10	138.50	131.20	68.90	49.60	24.00
Pecos Pueblo(PECO)	Hooten(1930)*	163.65	138.04	129.87	69.04	48.20	25.33
Arikara(ARIK)	Howells(1973)*	171.11	136.48	130.67	67.63	50.52	25.81
Peru(PERU)	Howells(1973)*	169.00	134.93	125.60	63.65	47.65	23.96

*Apud Steele and Powell(1992)
**Missing values replaced by the mean value of the variable calculated based on all other samples.

Table 3 - Principal component eigenvalues and eigenvectors for male and female samples(analysis based on size and shape).

	Males		Females	
	Component I	Component II	Component I	Component II
Eigenvalue	2.4625	1.5193	2.8036	1.1298
% of cum. variance	0.4104	0.6636	0.4672	0.6555
Eigenvector				
GOL	0.079	0.886	-0.320	0.903
XCB	0.740	-0.243	0.839	-0.319
ZYB	0.650	0.124	0.688	0.379
NPH	0.847	-0.156	0.866	0.223
NLH	0.873	0.110	0.824	0.135
NLB	0.084	0.789	0.309	0.028

Table 4 - Principal component scores for male and female samples used in Figures 1 and 2(analysis based on size and shape).

	Males		Females	
Series	Component I	Component II	Component I	Component II
LASC	-0.893	-0.008	-1.955	0.075
LASS	-1.283	0.033	-1.256	0.189
TEQU	-0.914	0.181	0.108	0.905
NAPI	-0.404	0.340	-0.036	-0.290
NORS	-0.118	0.201	-0.140	0.456
BERG	0.057	-0.682	0.175	-1.076
ZALA	-0.345	-0.144	-0.173	-0.097
GEOR	0.487	-1.488	0.272	-1.522
ARME	0.484	-1.464	1.002	-1.518
EGYP	-0.646	-0.256	-0.363	-0.512
TEIT	-1.332	0.670	-1.401	-0.073
DOGO	-1.495	-0.045	-1.188	-1.313
ZULU	-1.088	0.831	-1.021	0.408
TOLA	-1.264	0.636	-0.983	0.114
MOKA	0.402	0.591	0.095	-0.142
SAUS	-1.029	1.344	-1.293	0.945
TASM	-1.119	0.970	-1.367	0.001
UPCA	2.059	4.017	0.190	3.027
CHIN	0.498	-0.853	-	-
MINA	-0.184	-0.213	-0.161	-0.416
JOMO	-0.008	0.128	-	-
JAPA	-0.199	-0.858	-	-
BURI	2.176	0.239	2.022	-0.122
CHUC	1.566	-0.363	1.323	1.179
OSTI	1.059	-0.241	1.087	0.272
PRAL	1.115	0.105	1.045	1.227
ALEU	1.140	-0.766	1.436	-0.161
ESKI	0.275	0.010	0.286	1.481
NUSC	0.882	-1.178	0.976	-0.363
PECO	0.008	-0.870	0.749	-1.437
ARIK	0.762	-0.092	0.713	-0.129
PERU	-0.648	-0.775	-0.143	-1.108

Table 5 - Principal component eigenvalues and eigenvectors for male and female samples(analysis based on shape).

	Males		Females	
	Component I	Component II	Component I	Component II
Eigenvalue	2.4846	1.5704	2.5997	1.2340
% of cum. variance	0.4141	0.6758	0.4332	0.6389
Eigenvector				
GOL	-0.833	-0.390	-0.897	-0.192
XCB	0.503	0.537	0.637	0.233
ZYB	-0.247	0.769	0.043	0.923
NPH	0.817	-0.275	0.756	-0.116
NLH	0.703	-0.562	0.701	-0.507
NLB	-0.561	-0.382	-0.570	-0.145

Table 6 - Principal component scores for male and female samples used in Figures 1 and 2(analysis based on shape).

	Males		Females	
Series	Component I	Component II	Component I	Component II
LASC	-0.996	0.778	-1.665	-0.634
LASS	-1.304	0.654	-1.399	1.670
TEQU	-0.796	-0.329	0.232	-1.048
NAPI	-0.663	0.229	0.226	0.857
NORS	-0.059	-0.442	-0.122	-1.058
BERG	0.475	0.590	0.434	0.188
ZALA	0.047	-0.355	-0.071	-0.419
GEOR	1.368	0.732	0.869	-0.027
ARME	1.786	-0.438	1.724	-1.117
EGYP	0.221	-1.104	0.206	-1.720
TEIT	-1.001	-1.279	-1.265	-0.341
DOGO	-0.856	-0.168	-0.722	-0.643
ZULU	-0.873	-1.365	-1.149	-1.271
TOLA	-1.411	-0.110	-0.976	0.046
MOKA	-0.073	-0.187	0.002	-0.477
SAUS	-1.699	-0.464	-1.563	-0.306
TASM	-1.601	0.279	-1.633	0.352
UPCA	-0.679	-2.554	-0.970	0.124
CHIN	1.583	-1.498	-	-
MINA	-0.834	2.462	-0.426	3.448
JOMO	-0.792	1.871	-	-
JAPA	0.716	-0.382	-	-
BURI	1.289	0.255	1.474	-0.003
CHUC	1.356	-0.261	1.018	-0.342
OSTI	0.926	-0.075	0.911	-0.055
PRAL	0.452	0.382	0.487	0.442
ALEU	0.779	1.623	1.132	1.127
ESKI	0.266	-0.640	0.005	-0.452
NUSC	1.079	1.099	1.057	0.570
PECO	0.547	0.439	1.137	0.882
ARIK	0.668	-0.084	0.668	-0.016
PERU	0.078	0.343	0.379	0.224

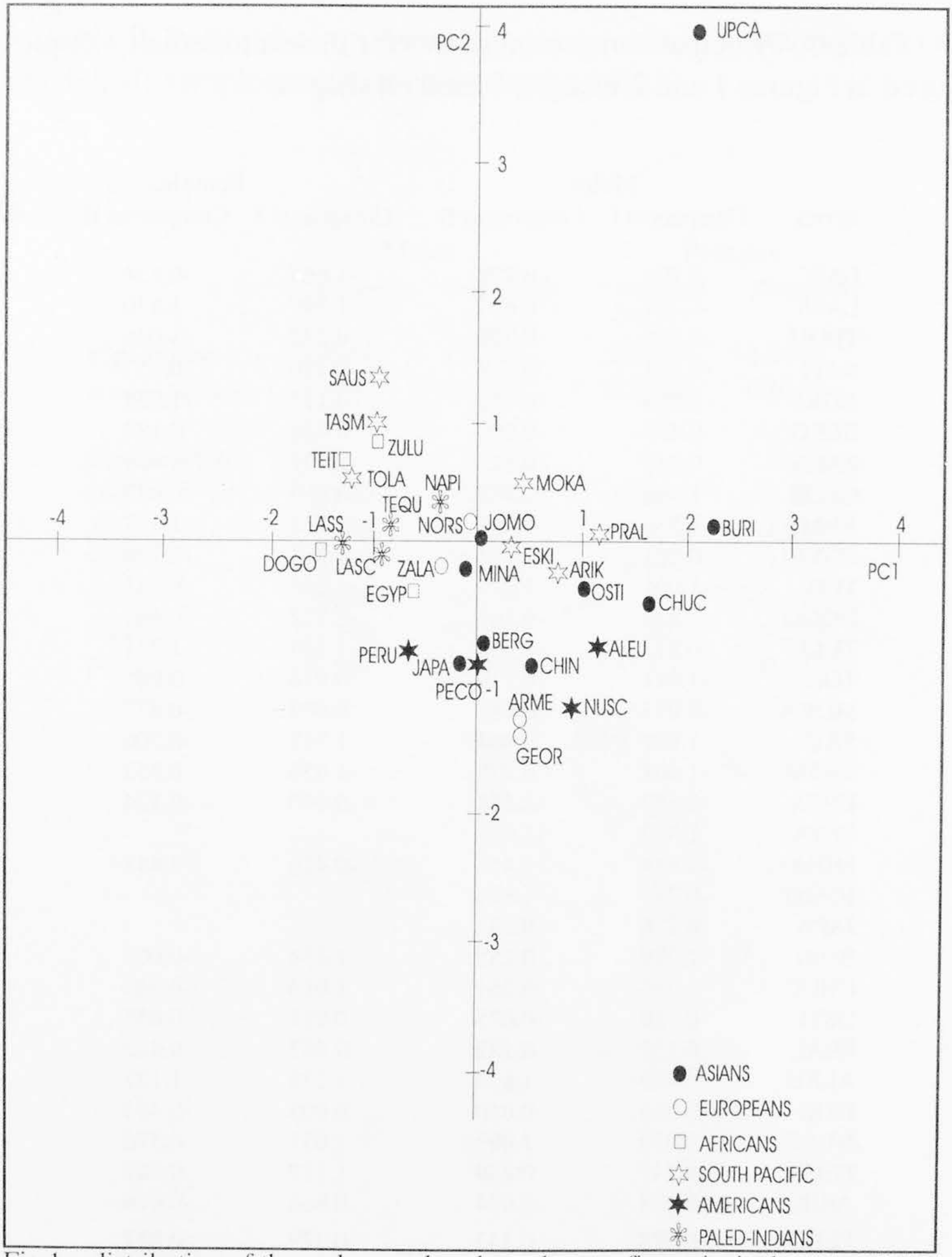

Fig.1 – distribution of the male samples along the two first principal components, when size and shape are used as anthropological markers.

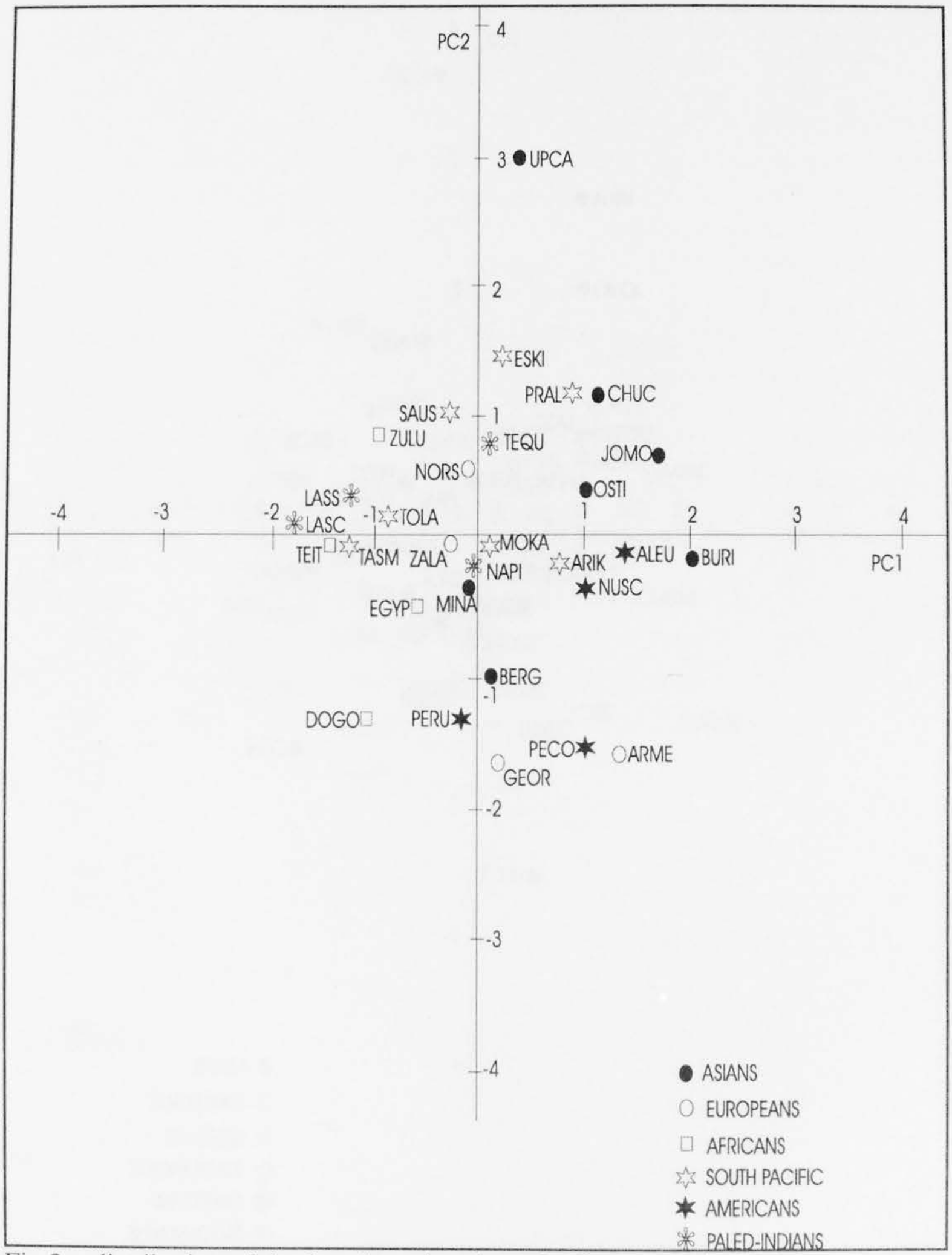

Fig.2 – distribution of the female series along the first two principal components, when size and shape are used as anthropological markers.

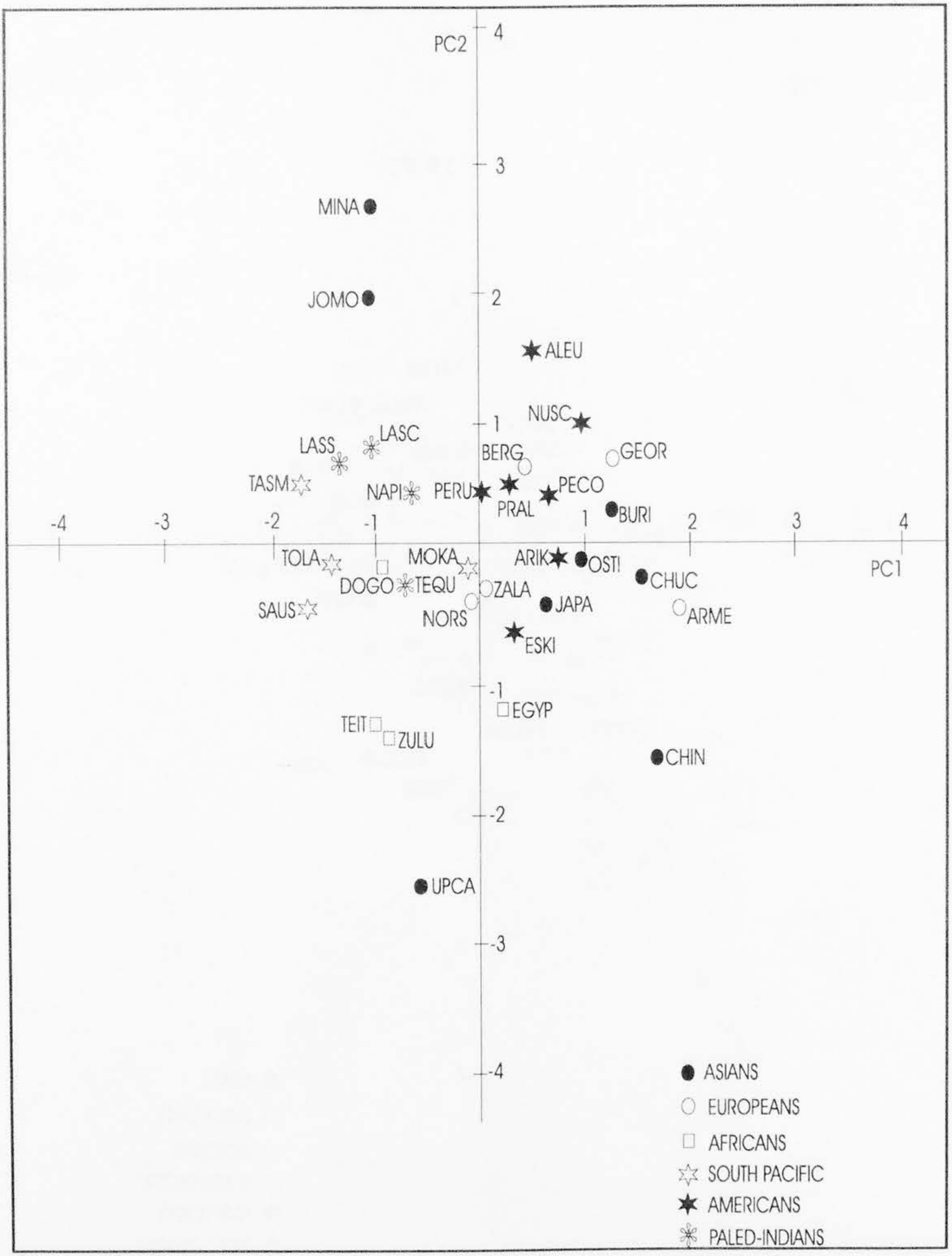

Fig.3 – distribution of the male series along the first two principal components, when shape alone is used as anthropological marker.

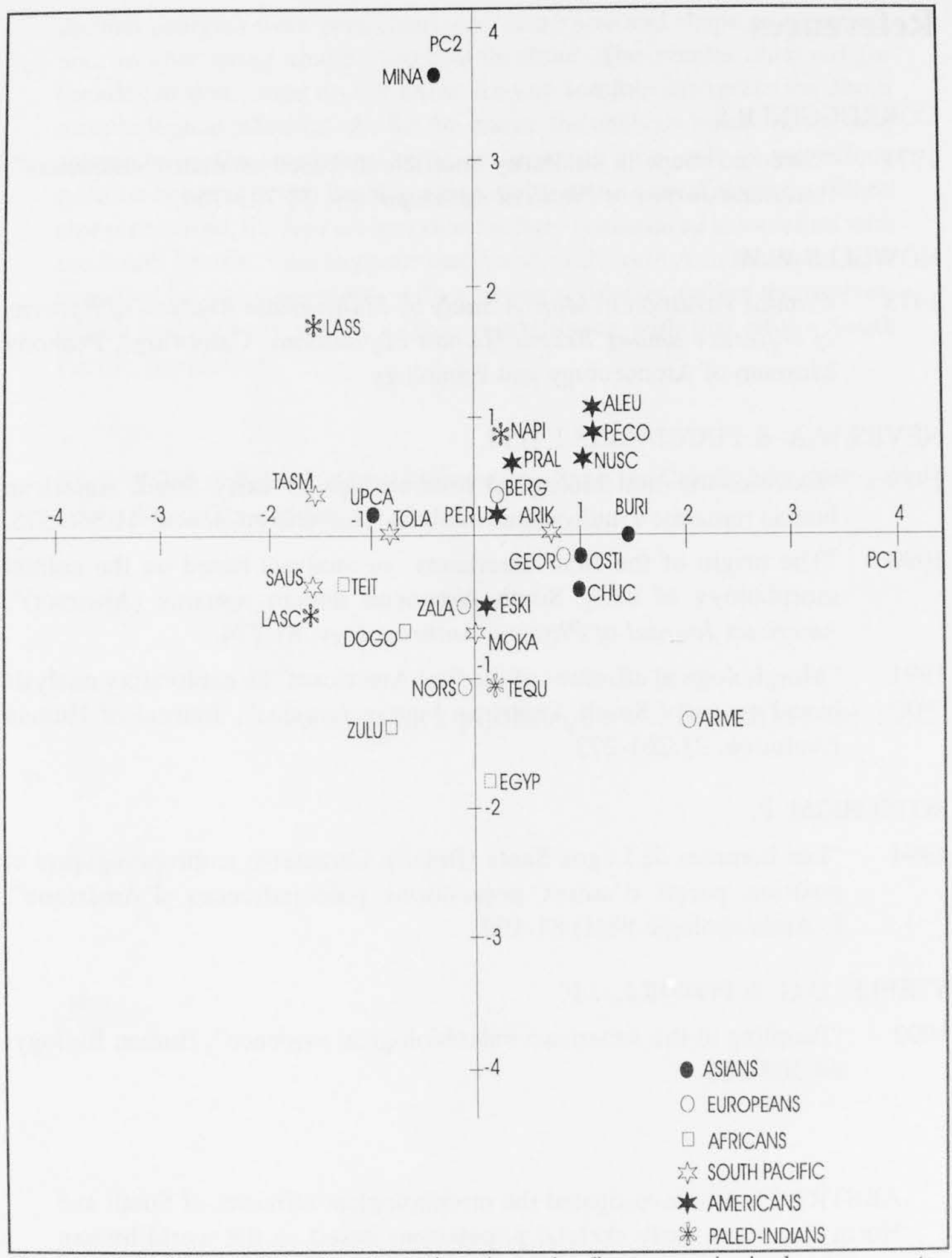

Fig.4 – distribuition of the female series along the first two principal components, when shape alone is used as anthropological marker.

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ABSTRACT: We investigated the morphological affinities of South and North American early skeletal populations based on the world human cranial variation, by means of a principal components analysis. Two

distinct analyses were performed, one using size and shape information, and another using shape information alone. The results obtained for females in both cases do not allow for any feasible interpretation about morphological affinities. As for the males, the analysis based on size and shape shows the four early American series in an equally intermediate position between South Pacific groups and South Asians/Europeans. When size is removed, the four series exhibit a more pronounced association with the South Pacific. This suggests that South and North America were both occupied by pre-mongoloids with a strong similarity among themselves, whose morphology shows a close resemblance with that of the South Pacific populations.

KEY-WORDS:Paleo-Indians, Multivariate Analysis, Cranial Morphology, Lagoa Santa Tequendama.

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