



РОССИЙСКАЯ АКАДЕМИЯ НАУК  
МУЗЕЙ АНТРОПОЛОГИИ И ЭТНОГРАФИИ  
ИМЕНИ ПЕТРА ВЕЛИКОГО (КУНСТКАМЕРА)  
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при поддержке  
фонда  
  
Династия

30 АПРЕЛЯ – 5 МАЯ 2012  
САНКТ-ПЕТЕРБУРГСКИЙ СЕМИНАР ПО ГЕОМЕТРИЧЕСКОЙ  
МОРФОМЕТРИИ  
ДЛЯ АНТРОПОЛОГОВ, БИОЛОГОВ И АРХЕОЛОГОВ



DR. GERMAN MANRIQUEZ. Lecture: "Shape variation in intentionally deformed skulls from Northern Chile: Applying GMM for understanding patterns of mobility in prehistoric human populations".

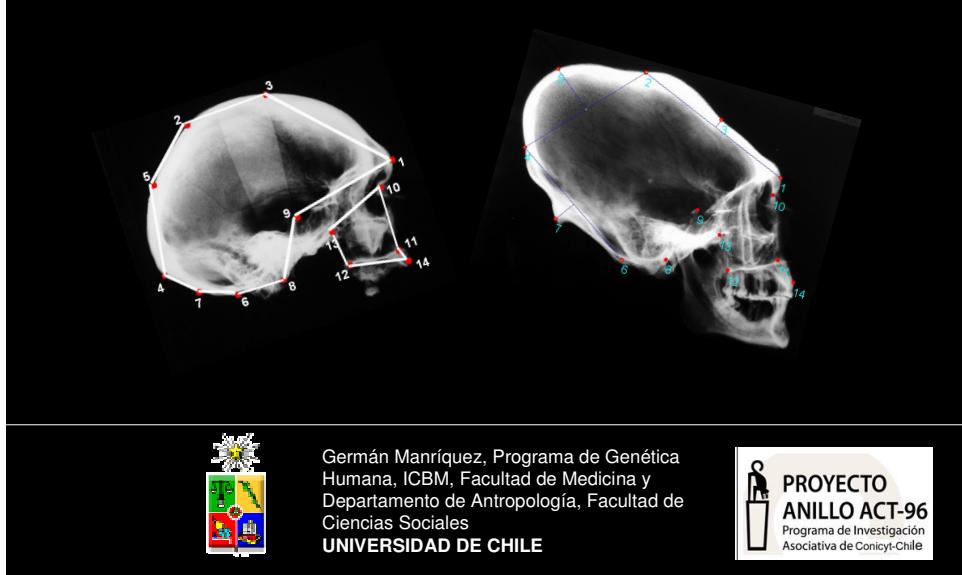


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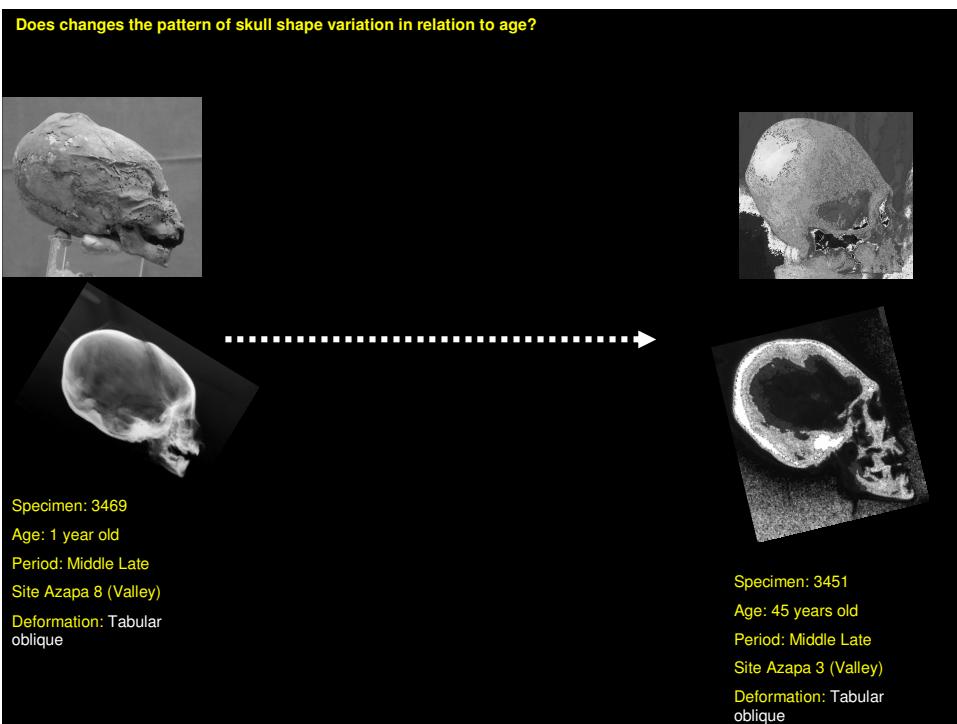
Saint Petersburg Workshop on Geometric Morphometrics for Anthropologists, Biologists and Archaeologists,  
30 April – 05 May 2012

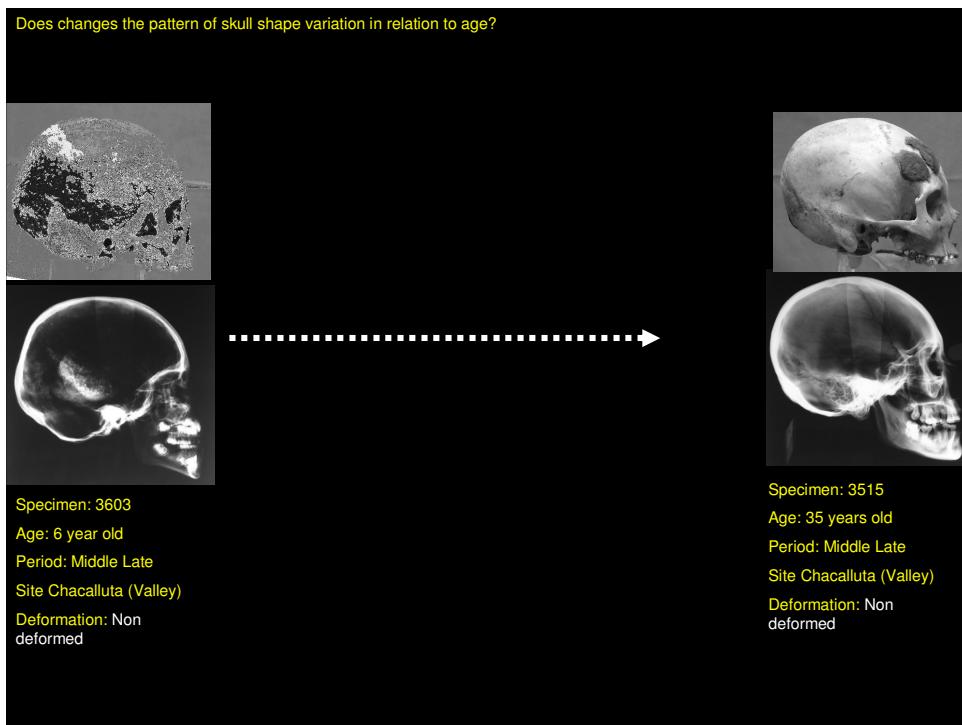
**Shape variation in intentionally deformed skulls from Northern Chile: Applying GMM for understanding patterns of mobility in prehispanic human populations**



Germán Manríquez, Programa de Genética Humana, ICBM, Facultad de Medicina y Departamento de Antropología, Facultad de Ciencias Sociales  
UNIVERSIDAD DE CHILE

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#### Rel warp analysis of the archaeological subadult sample from Arica

Rel warp analysis of the archaeological subadult sample (N= 29):  
Oblique N= 19, Erected N= 2, Non deformed N= 8

Data: 2D, Program: TPSDig

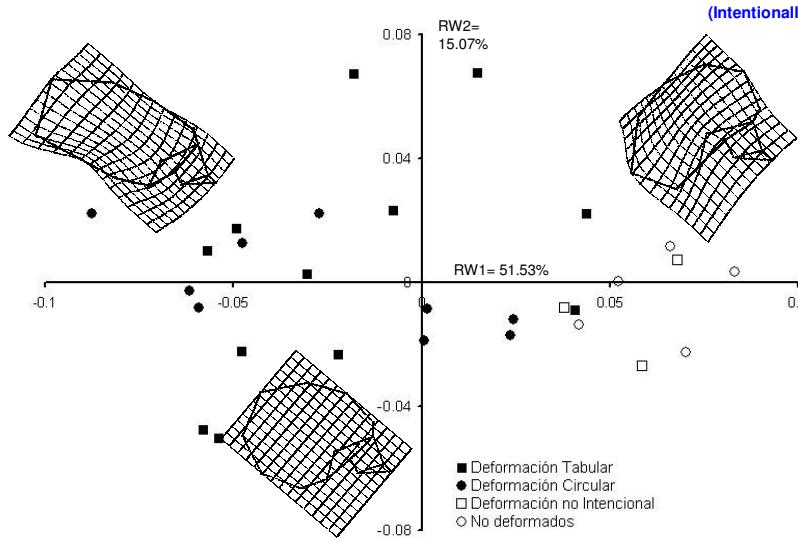
Causal Vectors:

Same geographic origin,

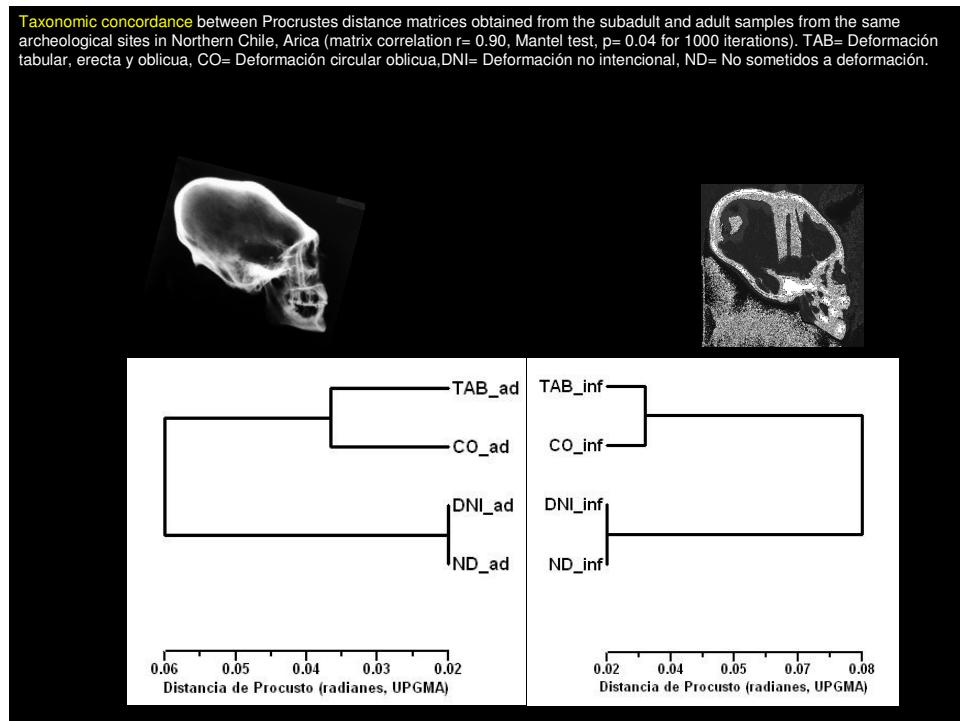
Same chronological period,

Different cultural practice  
(Intentionally deformed and non deformed)

Same age range



**Taxonomic concordance** between Procrustes distance matrices obtained from the subadult and adult samples from the same archeological sites in Northern Chile, Arica (matrix correlation  $r = 0.90$ , Mantel test,  $p = 0.04$  for 1000 iterations). TAB= Deformación tabular, erecta y oblicua, CO= Deformación circular oblicua,DNI= Deformación no intencional, ND= No sometidos a deformación.



Three dimensional analysis of skull shape variation in human populations from different geographical origins ( $N = 162$ , PC1= 24.4%, PC2= 19.7%)

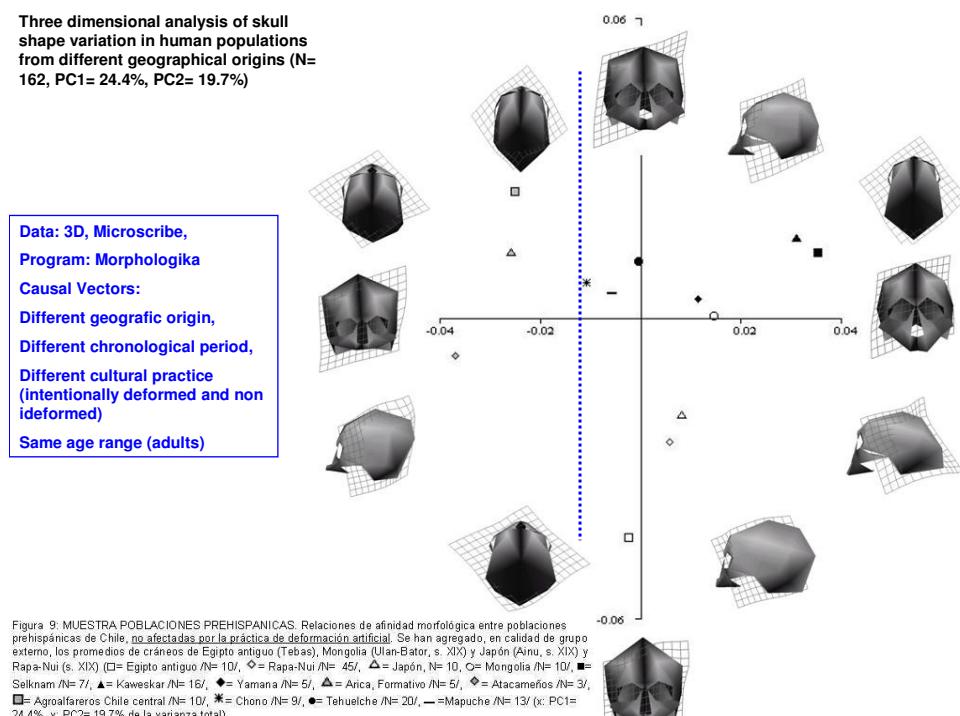
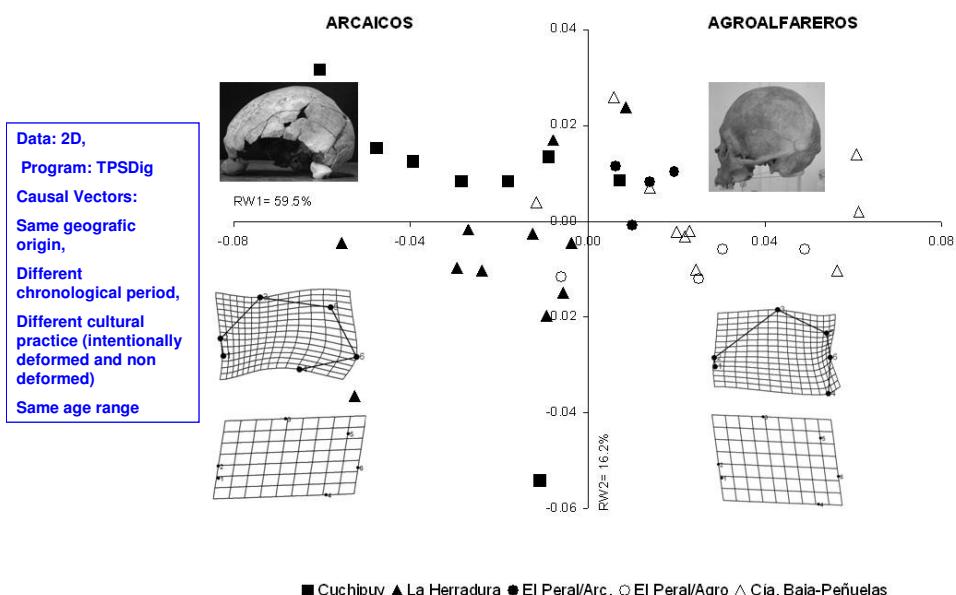
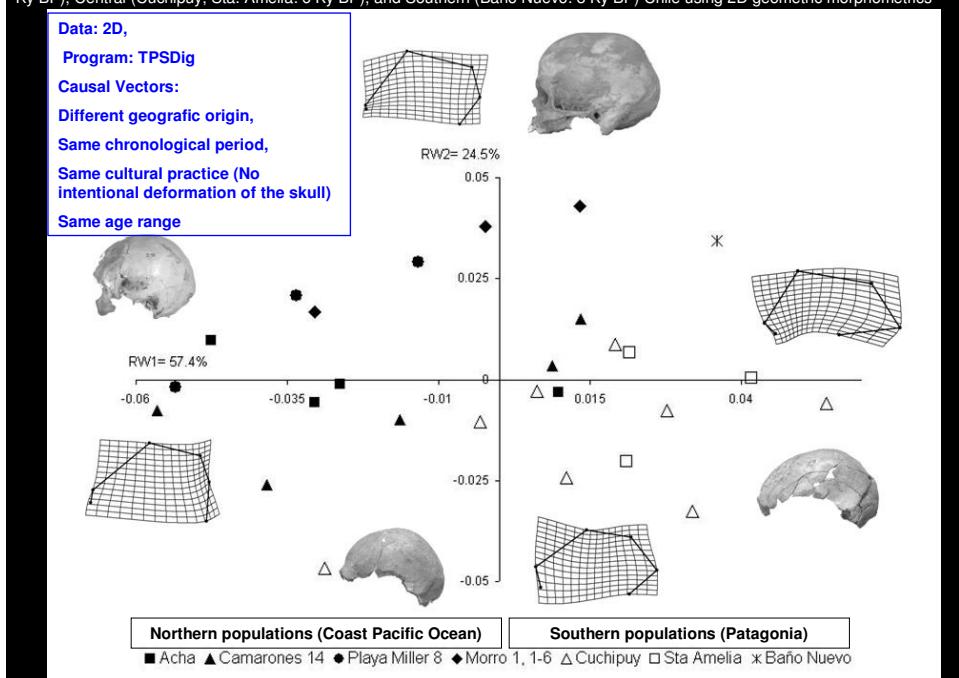
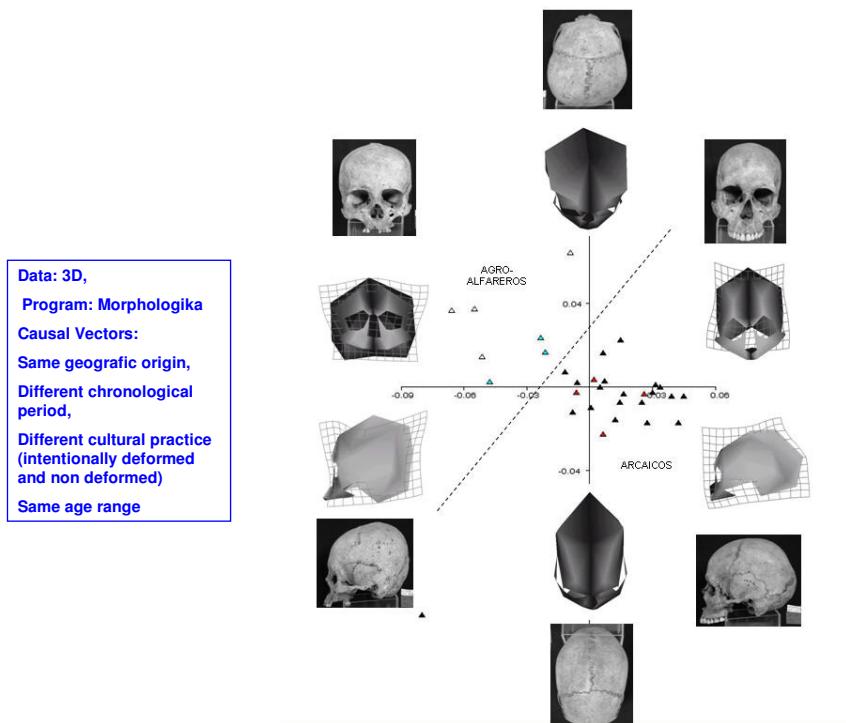


Figura 9: MUESTRA POBLACIONES PREHISPANICAS. Relaciones de afinidad morfológica entre poblaciones prehispánicas de Chile, no afectadas por la práctica de deformación artificial. Se han agregado, en calidad de grupo externo, los promedios de cráneos de Egipto antiguo (Tebas), Mongolia (Ulan-Bator, s. XIX) y Japón (Aizu, s. XIX) y Rapa-Nui (s. XIX) (□= Egipto antiguo /N= 10/, ◇= Rapa-Nui /N= 45/, ▲= Japón, N= 10, ○= Mongolia /N= 10/, ■= Selknam /N= 7/, ▲= Kaweskär /N= 16/, ◆= Yamana /N= 5/, △= Arica, Formativo /N= 5/, ♦= Atacameños /N= 3/, □= Agroalfareros Chile central /N= 10/, \*= Chono /N= 9/, ●= Tehuelche /N= 20/, —= Mapuche /N= 13/ (x: PC1= 24.4%, y: PC2= 19.7% de la varianza total).

Analysis of skull shape variation in **archaic** prehispanic populations of Northern (Acha, Camarones, Playa Miller 8, Morro 1, 1-6): 8-6 Ky BP), Central (Cuchipuy, Sta. Amelia: 6 Ky BP), and Southern (Baño Nuevo: 8 Ky BP) Chile using 2D geometric morphometrics





### Intentional Cranial Deformation in northern Chilean archaeological populations: a radiographic and geometric morphometric approach. (Grant Fondecyt UChile, 1050279)

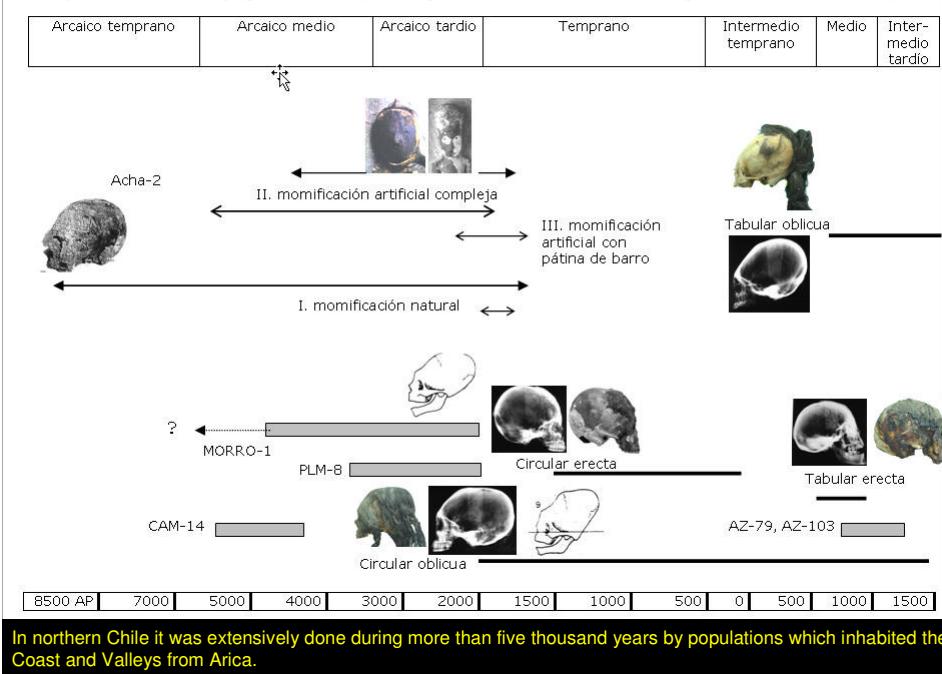
Figura 1: Distribución mundial de la práctica de la deformación intencional del cráneo (DIC) y su presencia en las poblaciones prehispánicas de Arica, Chile (a, c-g, i; Gerszten & Gerszten, 1995; b, h: Dembo & Imbelloni, 1938)



j. En Chile la DIC se practicó por un lapso de, al menos, 4 mil años, siendo sus poblaciones más representativas las de la costa y valles de Arica. (cráneos secos, CMBe-MNHN, radiografías, Serv. Dento Máx-Facial Hosp. Clín. U. de Chile, en Maríquez, González, Salinas y Espouey, in press).

Intentional cranial deformation is a long lasting and worldwide form of permanent modification of the main human head distinctive anatomical attributes.

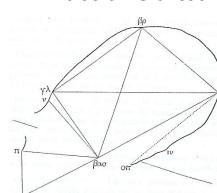
Figura 2: Cronología de la deformación intencional del cráneo en Arica y su relación con las prácticas de momificación en las poblaciones del complejo Chinchorro ( ► = según Aufderheide et al, 1993; → = según Allison et al, 1981, 1984)



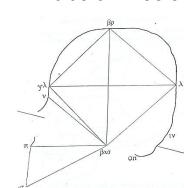
**Classification of intentional cranial deformation after Dembo & Imbelloni (1938) for pre-hispanic populations from Southern Andes (Argentina, Chile)**

**Based on the resulting shape and also on the deforming device used to obtain that shape**

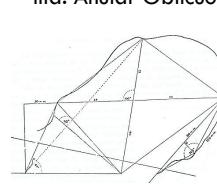
#### I. Tabular Oblicuo



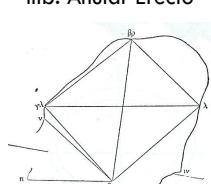
#### II. Tabular Erecto



#### IIIa. Anular Oblicuo



#### IIIb. Anular Erecto

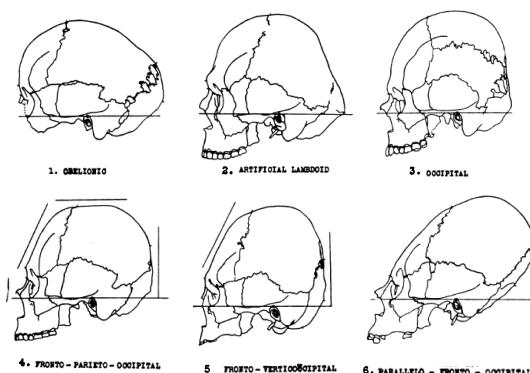


Tabulares	Oblicuos I	Erectos II
Anulares	IIIa	IIIb

**Classification of intentional cranial deformation after Neumann (1947) for pre-hispanic populations from USA, applied also to Central Andes (Peru, Bolivia).**

**Based only in the resulting shape, in despite of the deforming device used to obtain it**

Types of Artificial Cranial Deformation in the Eastern United States  
Author(s): Georg K. Neumann  
Source: *American Antiquity*, Vol. 7, No. 3 (Jan., 1942), pp. 306-310



**The problem of classification in Darwin: Natural vs Artificial systems and importance of homologous characters**

"Let us now consider the **rules followed in classification**, and the **difficulties** which are encountered on the view that classification either gives some unknown plan of creation, or is simply a scheme (...) of placing together the forms most like each other.

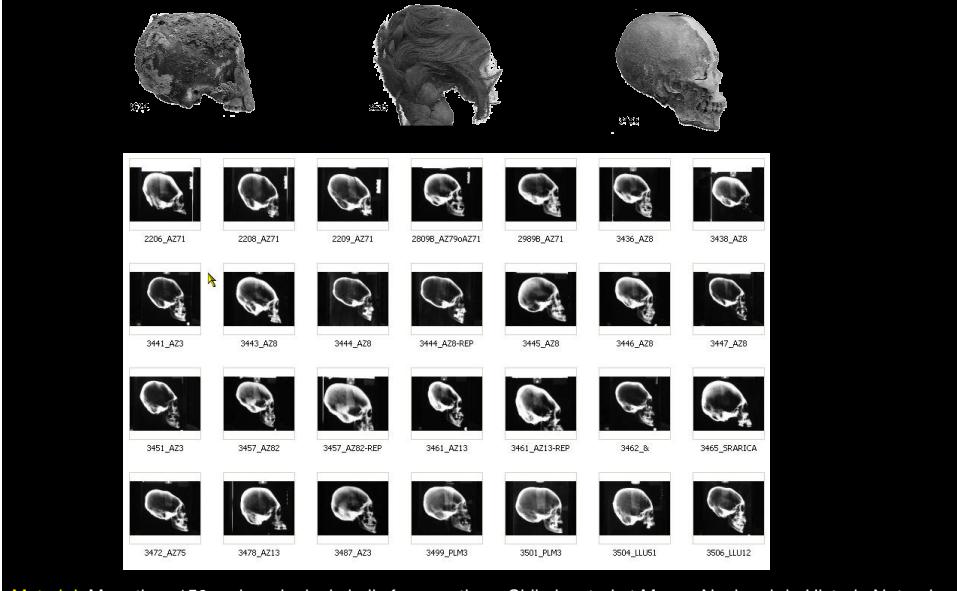
(...) No one regards the external similarity of a mouse to a shrew, of a dugong to a whale, of a whale to a fish, as of any importance. These resemblances (...) are ranked as **merely adaptive or analogical characters**;"

It may even be given as a general rule, that the less any part of the organisation is concerned with special habits, the more important it becomes for classification"

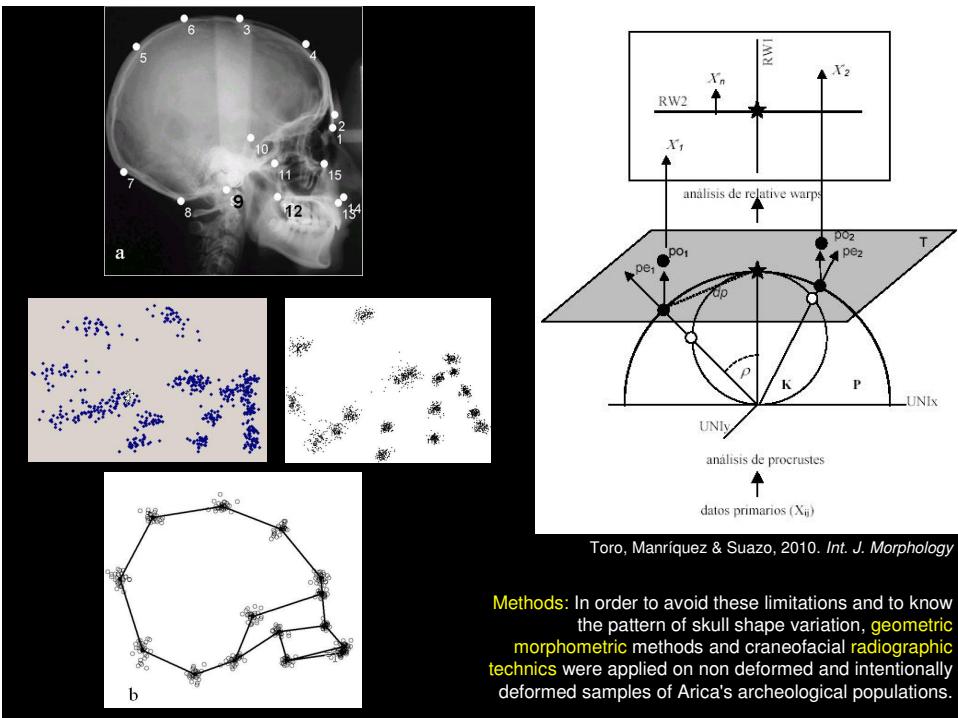
Ch. Darwin 1859 "On the Origin of Species by means of Natural selection"  
Chapter 13 - Mutual Affinities of Organic Beings:  
Morphology: Embryology: Rudimentary Organs



**The technic (X-Ray):** In spite of the importance that the study of this practice has had in anthropological research, biocultural remains such as hear, mould and textiles preclude the morphometric analyses commonly performed onto the clean skull. Moreover, the biological consequences of this practice are still unknown



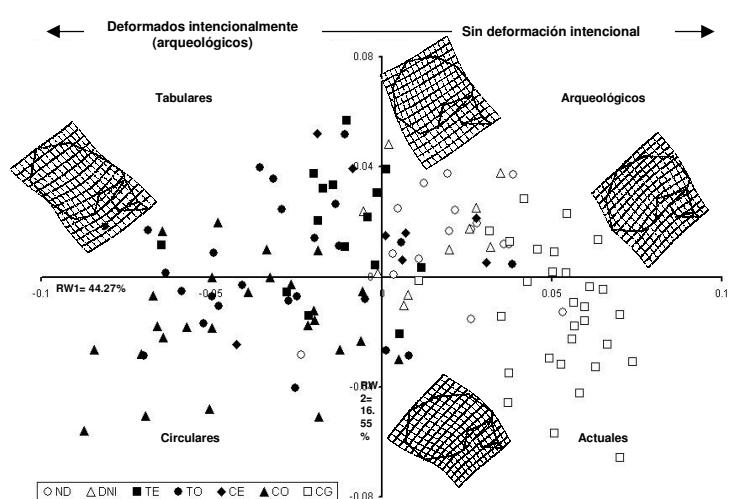
**Material:** More than 150 archaeological skulls from northern Chile located at Museo Nacional de Historia Natural, Santiago, colección Blanco Encalada.

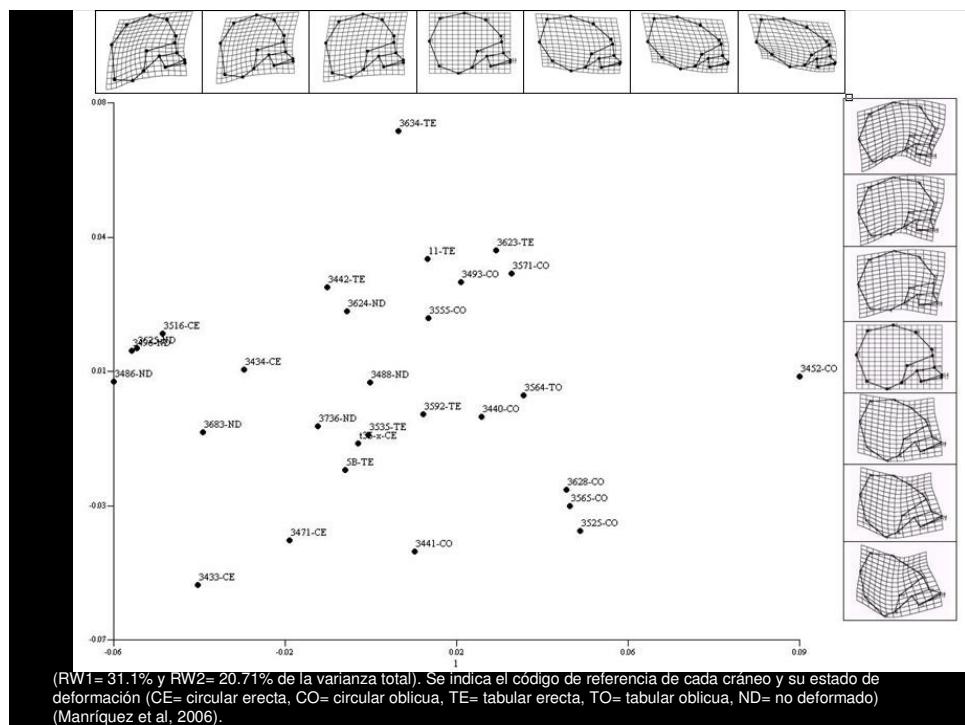


Landmark and outline data used to study the skull shape variation in Chilean archaeological and modern populations.

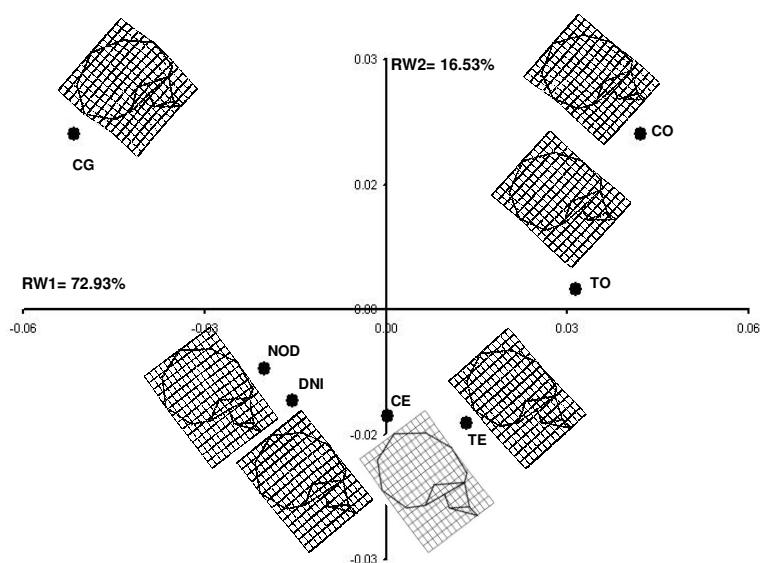
Hito	Nombre	Definición anatómica	Tipo	Referencia Bibliográfica
1	Glabela (Gl)	Punto más prominente y anterior del hueso frontal en la zona superciliar	III	Björk, 1947
2	Bregma (Br)	Sutura fronto-parietal	I	Delaire, 1978
3	Frontal (Fr)	Punto construido geométricamente por la perpendicular, en el punto medio, de la línea recta que une Glabela y Bregma	*	Manríquez et al, 2006
4	Lambda (Ld)	Sutura parieto-occipital	I	Manríquez et al, 2006
5	Bóveda (Bd)	Punto construido geométricamente por la perpendicular, en el punto medio, de la línea recta que une Bregma y Lambda	*	Manríquez et al, 2006
6	Ophistion (Op)	Borde posterior del foramen magno	I	Björk, 1947
7	Occipital (Oc)	Punto construido geométricamente por la perpendicular, en el punto medio, de la línea recta que une Lambda y Ophistion	*	Utilizado para este estudio
8	Basión (Ba)	Proyección normal del punto anteroinferior del foramen magnum	I	Björk, 1947
9	Apófisis clinoides posterior (Clp)	Punto más ántero-superior de las apófisis clinoides posteriores	III	Delaire, 1978
10	Frontomaxilar (Fm)	Punto de mayor radiopacidad a la altura de la sutura frontomaxilar	I	Delaire, 1978
11	Nasopalatino (Np)	Punto de entrada, en el piso nasal, del conducto nasopalatino	I	Delaire, 1978
12	Espina nasal posterior (Enp)	Punto de intersección entre el paladar duro y la fosa pterigopalatina	I	Björk, 1947
13	Pterigoideo (Pi)	Punto más póstero-superior de la fosa pterigomaxilar	III	Ricketts et al, 1982
14	Prostión (Pr)	Punto más anteroinferior del proceso alveolar maxilar	I	Björk, 1947

#### Rel warp analysis of the adult sample

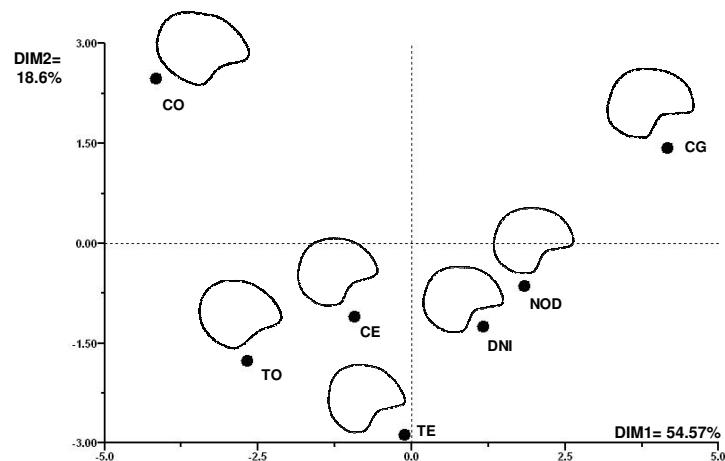




Relative warp analysis of skull shape variation in intentionally deformed and non deformed archaeological populations from Northern Chile (Arica). Modern populations are represented by a skull sample from General Cemetery from Santiago (points correspond to the consensus configuration of each sample). TE= Tabular erecta (N= 15), TO= Tabular oblicua (N= 25), CE= Circular erecta (N= 8), CO= Circular oblicua (N= 26), DNI= Deformado no intencional (N= 10), NOD= No deformado (N= 16), CG= Cementerio General, Santiago (N= 30).



**Outline (Fourier) analysis of the same samples used in the Rel warp analysis of landmark data**



**Taxonomic concordance** between distance matrices obtained using landmark and outline data in adult samples from coast and valley archeological sites in Northern Chile, Arica (matrix correlation  $r = 0.96$ , Mantel test,  $p = 0.01$  for 1000 iterations). TAB= Tabular Deformation CIR= Annular deformation,DNI= Non intentional deformation, ND= Non deformed, CG= General Cemetery /modern/.

