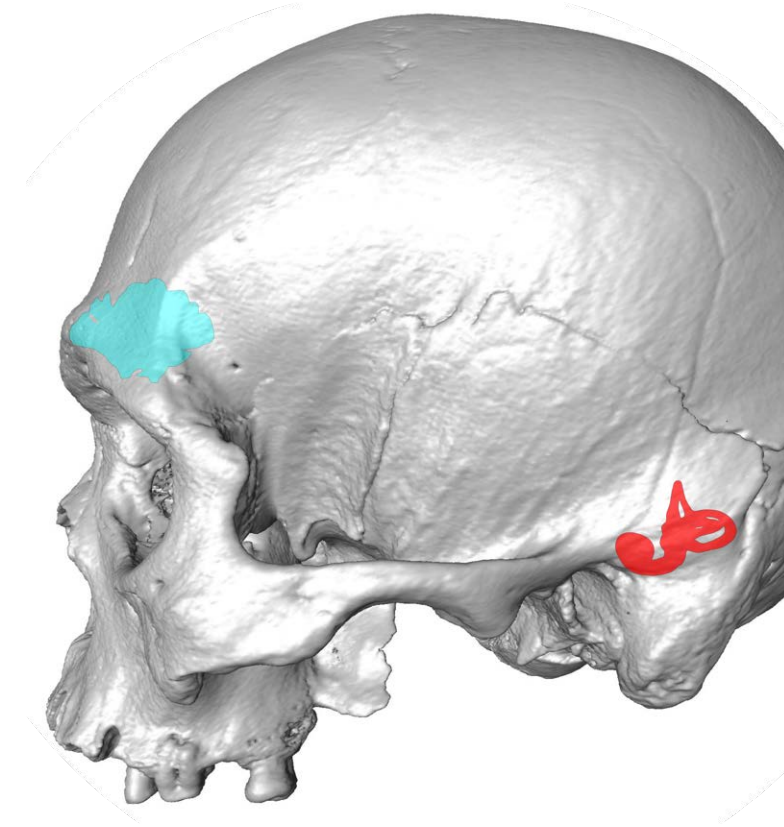
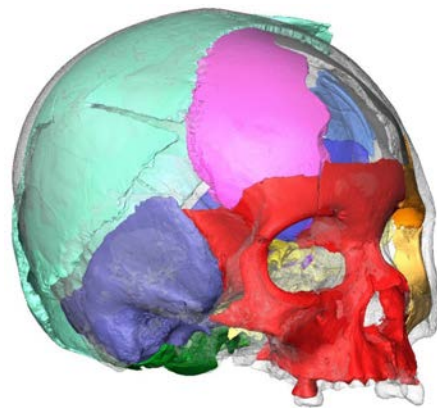
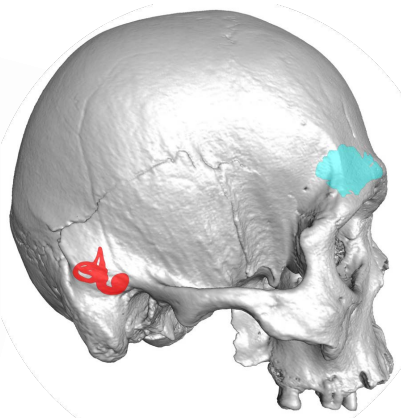
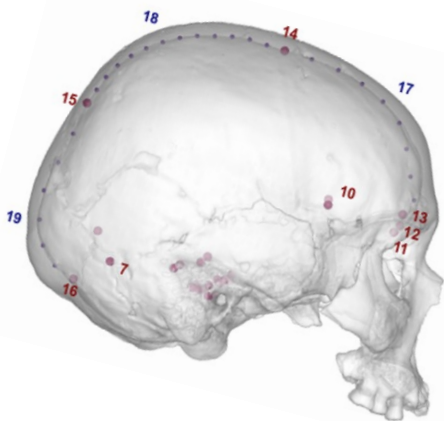
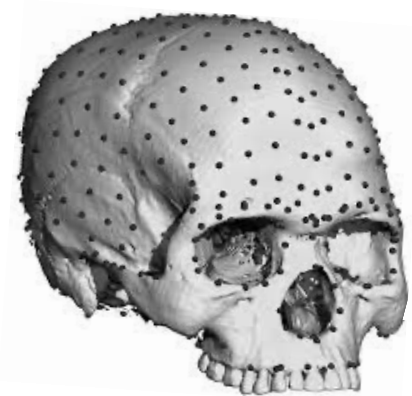


Virtual anthropology & human identification

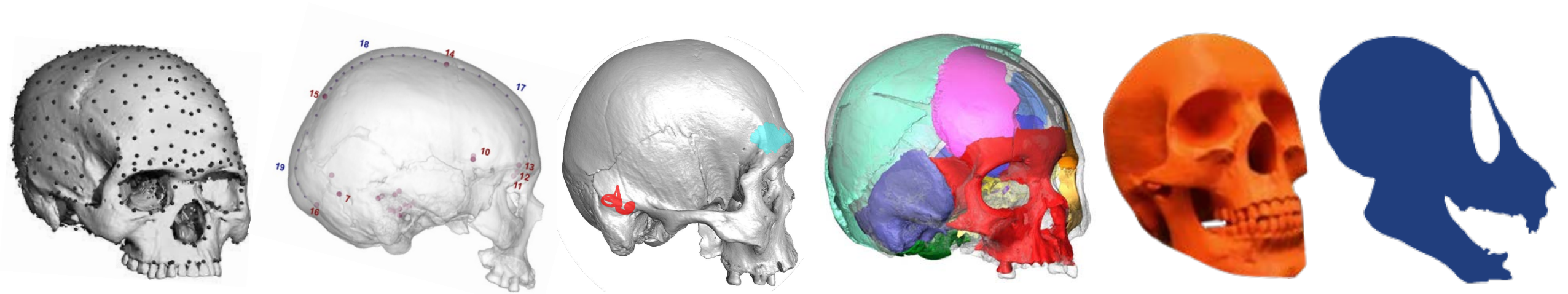
Lumila Menéndez
Mirsha Quinto-Sánchez



What is “virtual anthropology”?



What is “virtual anthropology”?

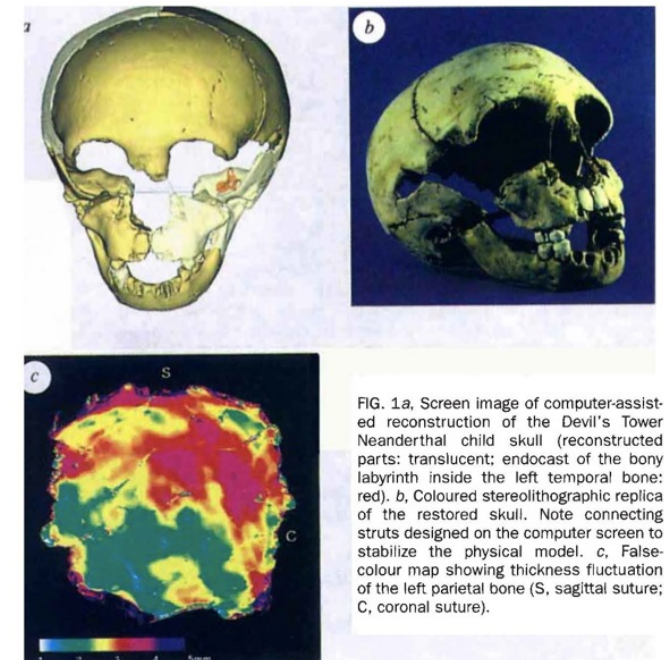


Virtual Anthropology is a multidisciplinary and quantitative approach to studying anatomical data, particularly that of humans, their ancestors, and closest relatives, in three or four dimensions (space or space-time) (Weber and Bookstein, 2010).

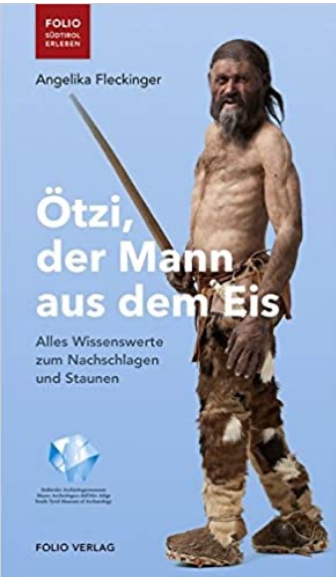
3D analysis of anthropological objects within a computational environment (Weber et al., 1998).

Origin in 1990s thanks to advances and access to digital equipment.

Neanderthal computer skulls



Zollikofer et al. 1995, *Nature*

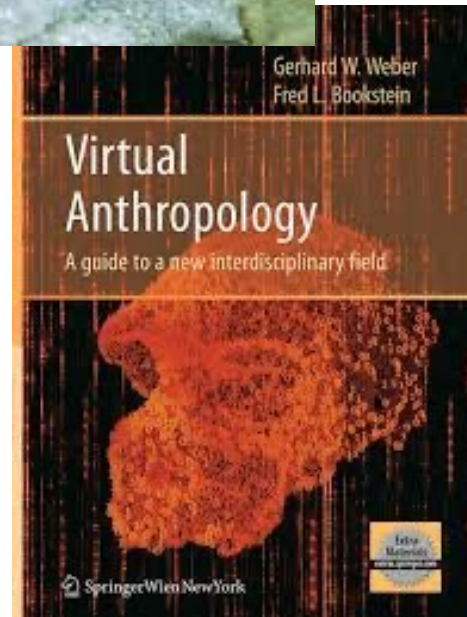


Some Anthropological Aspects of the Prehistoric Tyrolean Ice Man

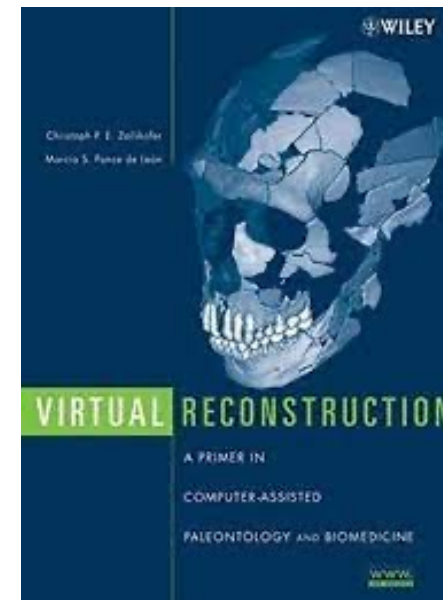
Horst Seidler, Wolfram Bernhard, Maria Teschler-Nicola, Werner Platzer, Dieter zur Nedden, Rainer Henn, Andreas Oberhauser, Thorstein Sjøvold

The corpse of a Late Neolithic individual found in a glacier in Oetzal is unusual because of the intact nature of all body parts that resulted from the characteristics of its mummification process and its protected geographical position with regard to glacier flow. Anthropological data indicate that the man was 25 to 40 years old, was between 156 and 169 centimeters in stature, had a cranial capacity of between 1500 and 1560 cubic centimeters

Seidler et al. 1992, *Science*



Weber & Bookstein (2010)



Zollikofer & Ponce de León (2005)

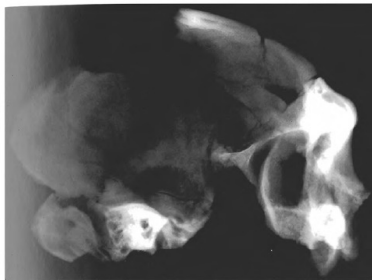
WILHEM RÖNTGEN

First radiography
of living tissue



1895

First X-rays of a fossil
(Krapina Neanderthal)



1902 (1896-1980s)

GODFREY NEWBOLD
HOUNSFIELD

Prototype computed
tomography (CT)



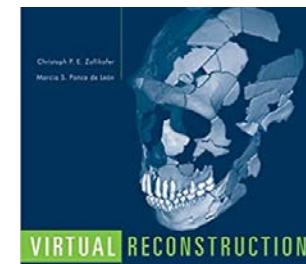
1972 (1979)

Wide use for studying fossils
Instrumentation improvement

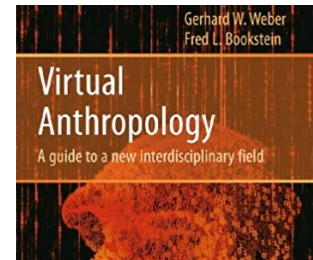


1980s-1990s

Systematization and development
of work flow protocol

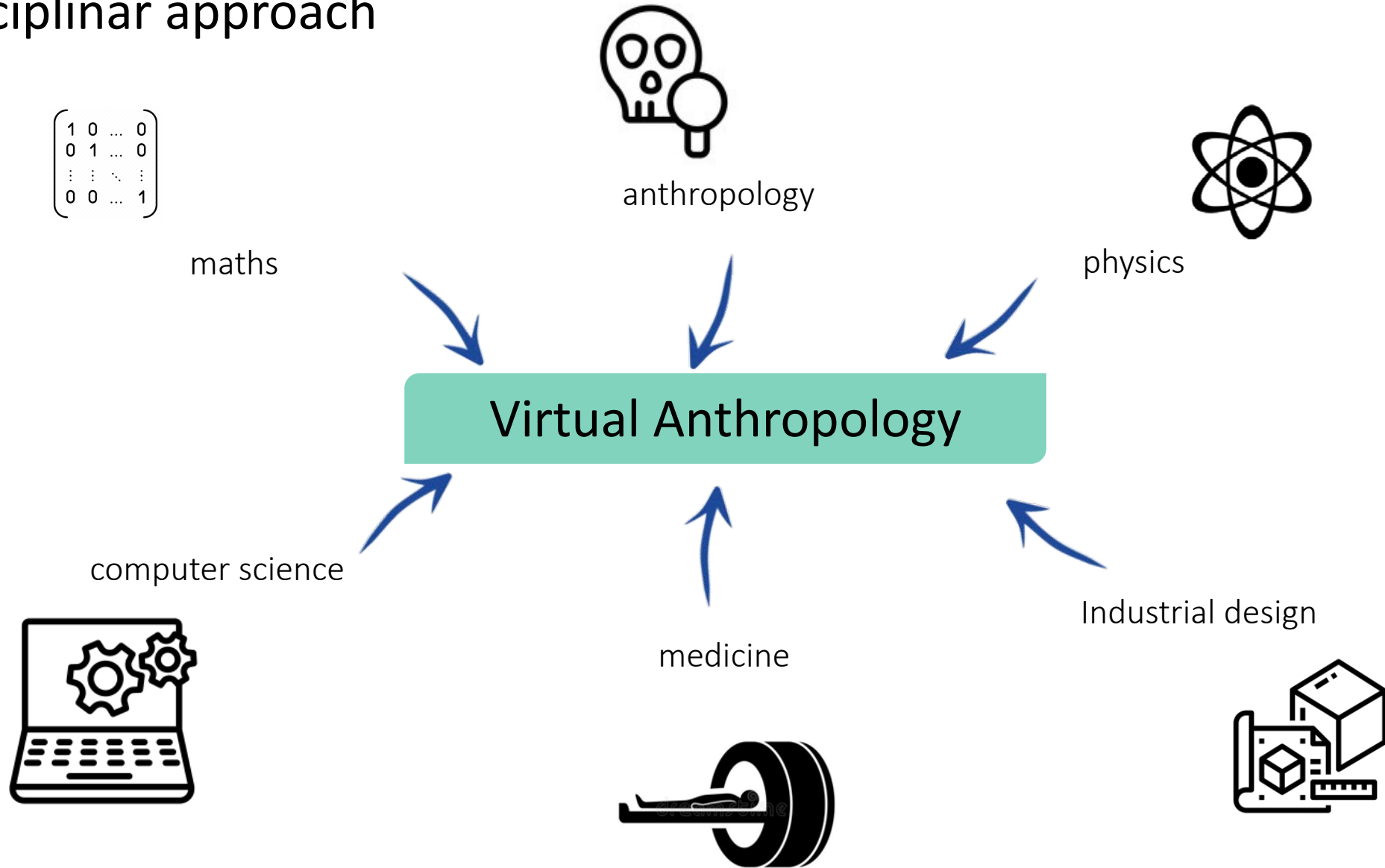


2005

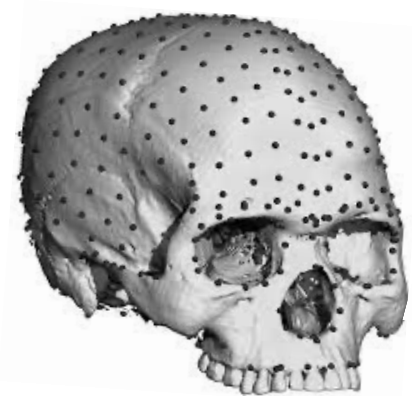


2011

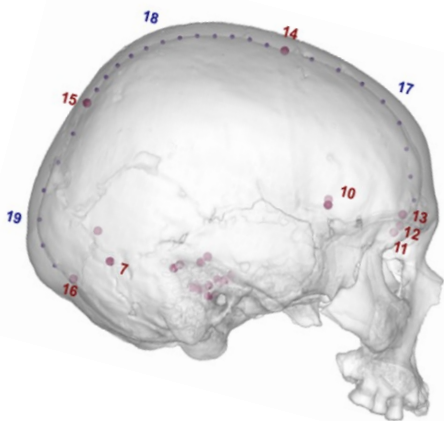
Multidisciplinary approach



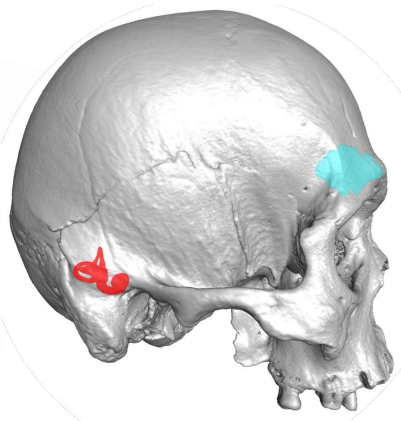
The Virtual Anthropology protocol and tool-kit



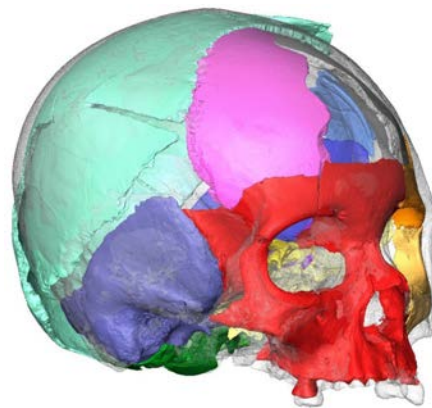
DIGITISE



COMPARE



EXPOSE



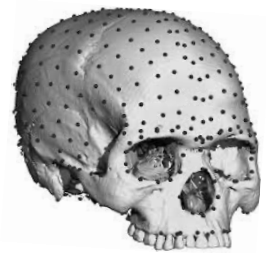
RECONSTRUCT



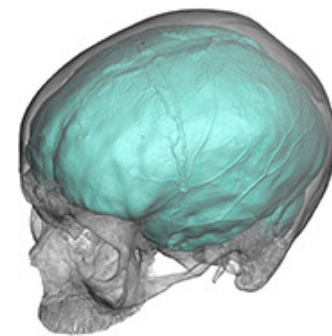
MATERIALISE



SHARE



DIGITISE



Microscribe



Photogrammetry



Surface-scanner

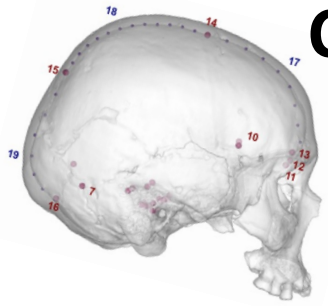


Medical CT-scanner

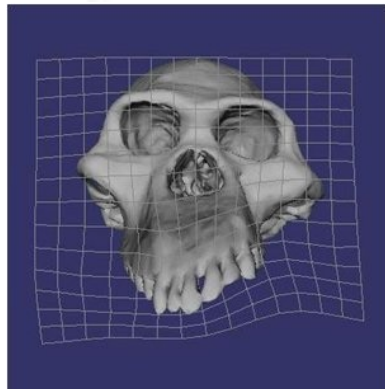
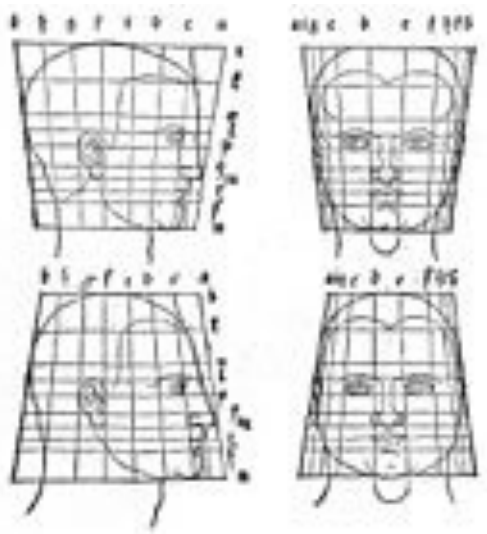


Micro-CT-scanner

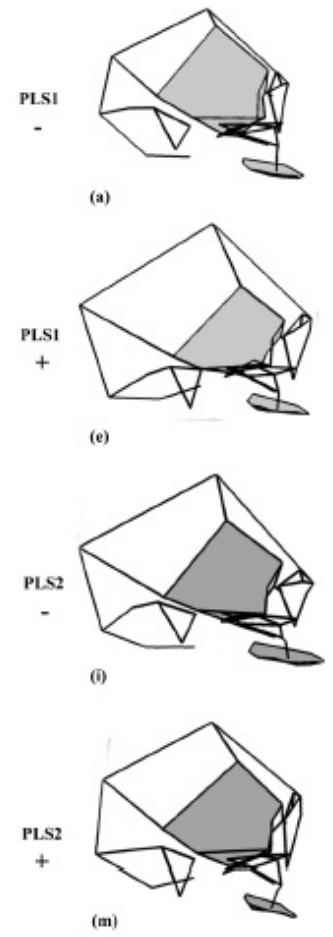
COMPARE



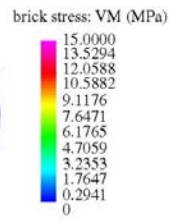
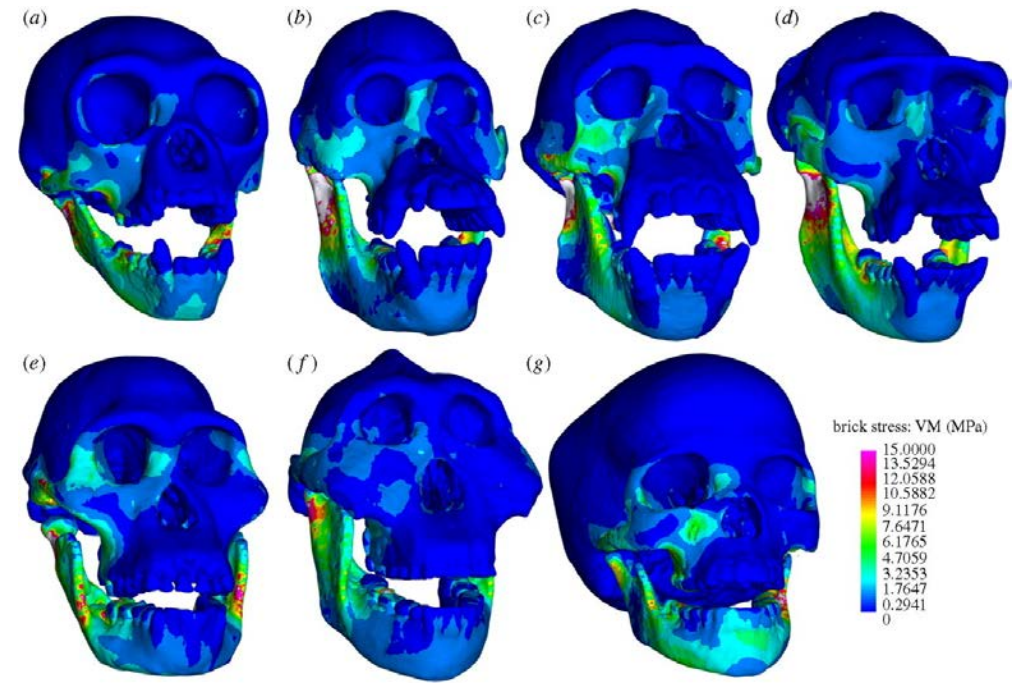
Deformation grids

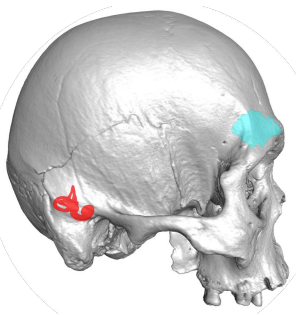


Wireframes



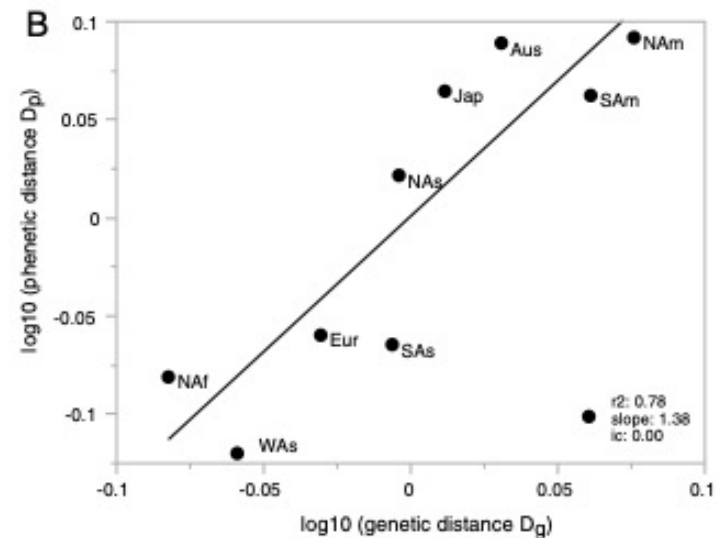
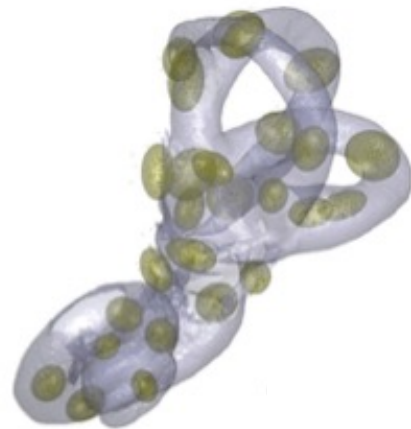
Heatmaps



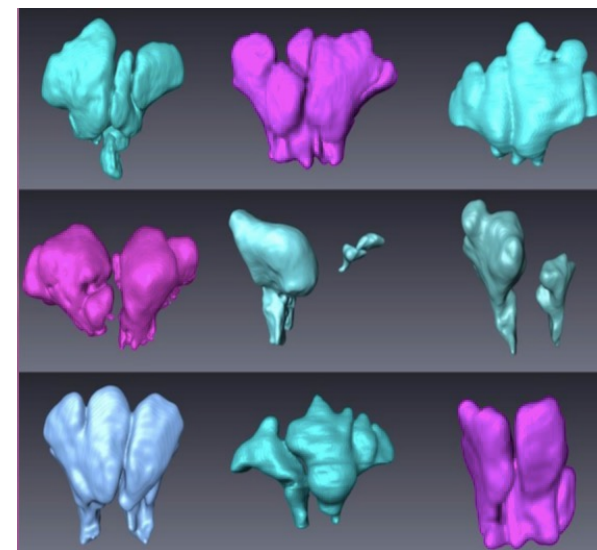
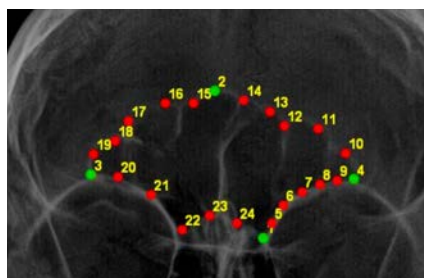


EXPOSE

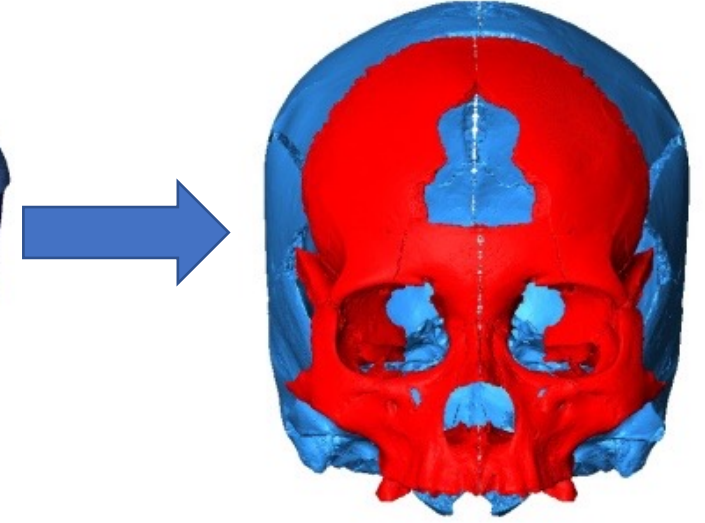
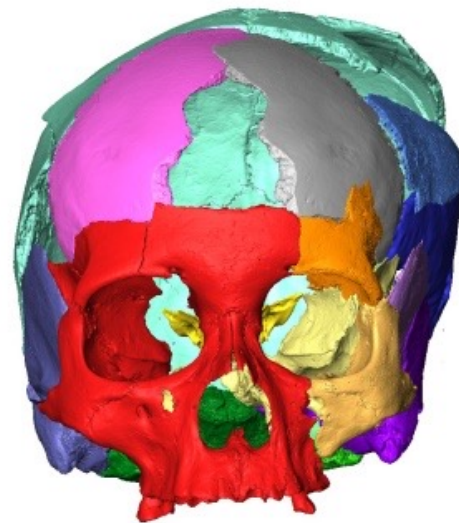
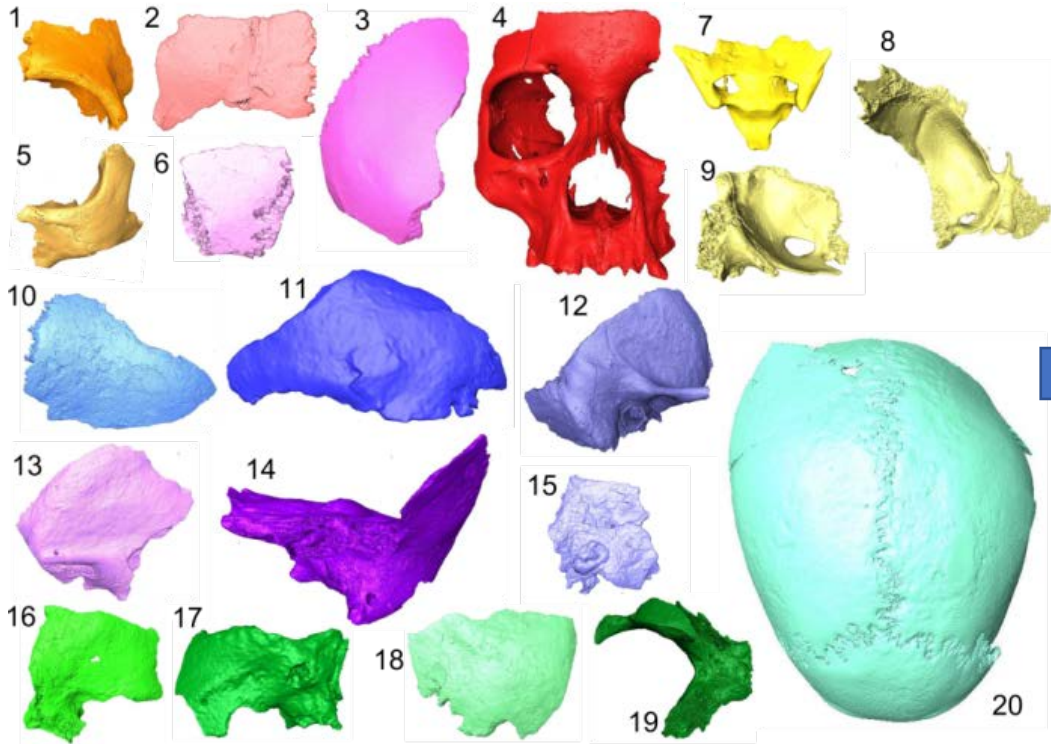
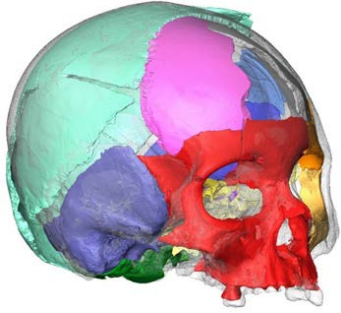
Bony labyrinth
Population history signature



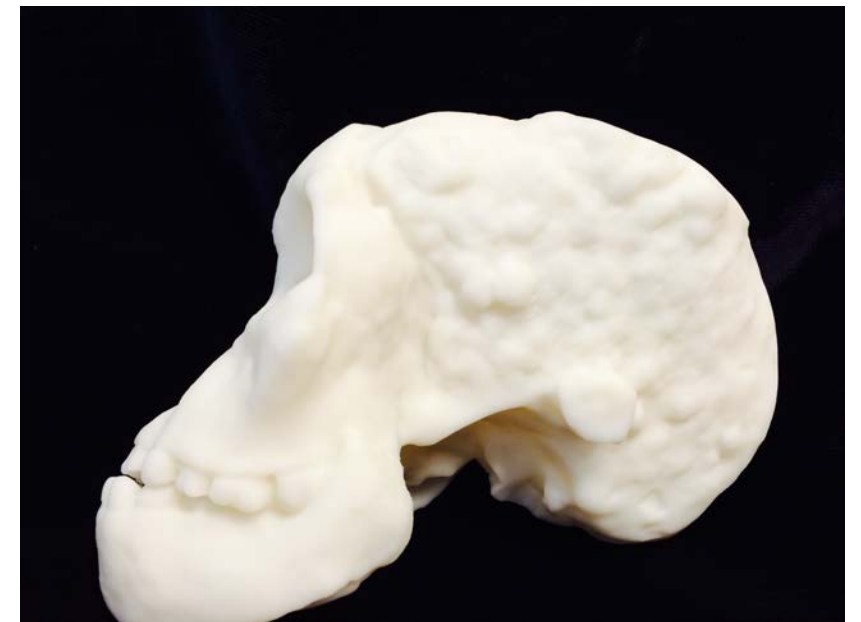
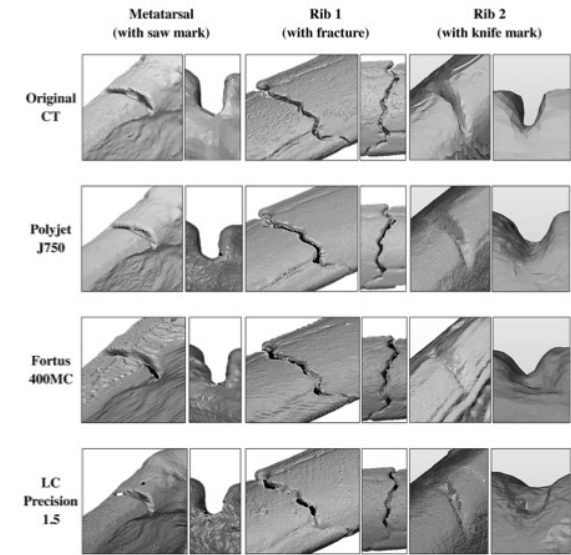
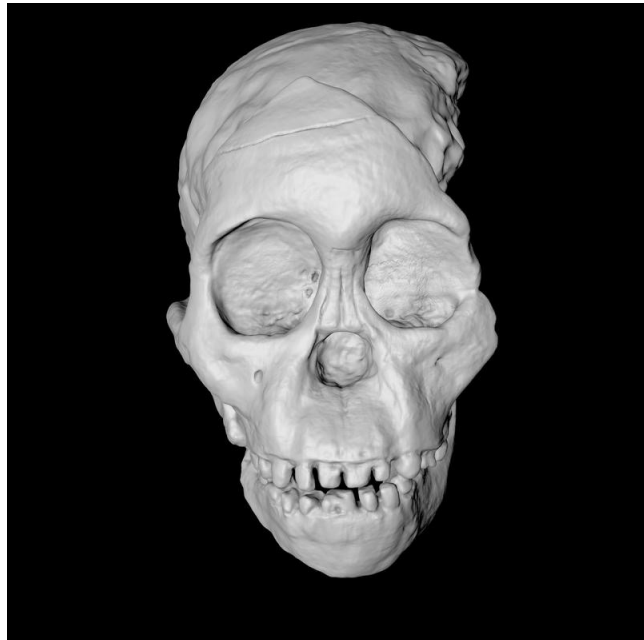
Frontal sinus
Unique signature



RECONSTRUCT



MATERIALISE





SHARE

NESPOS

Die Bündelung wissenschaftlicher Daten und Ergebnisse in digitaler Form zum Eiszeitalter ist die zentrale Aufgabe von NESPOS. Besondere Bedeutung haben dabei 3D Objekte. Zum Schutz der wertvollen Originalfunde ist es nötig, den unmittelbaren Kontakt durch den Wissenschaftler oder Aussteller auf ein Minimum zu reduzieren. Neu ermöglichen die Erstellung präziser digitaler Kopien, die vielfältig genutzt werden können. So können die Vermessungen, typologischen Klassifikationen und stilistischen Vergleichen an der digitalen Kopie werden. Ebenso beschädigen Schnitte durch das Objekt nicht das Original. Weitere Anwendungen: Präsentation, Raumanalyse, Erstellung von Kopien für Museum und Didaktik.

Weitere Infos [hier](#)



DigitalMorphology
A National Science Foundation Digital Library at The University of Texas at Austin

Home
About DigitalMorph
DigMorph Help
Sponsors
Links
Recent Publications
DigMorph People
Browse the Library by:
Scientific Names
Common Names
What's Popular?
Learn More
X-ray CT
3-D Printing
Overview Pages
Dinosaurs
Tapirs
Horned Lizards @ Endocasts
A Production of
UTCT
UT Geosciences
TAMU
DigMorph Contributors
Expert annotation

The Digital Morphology library is a dynamic archive of information on digital morphology and high-resolution X-ray computed tomography of biological specimens. Browse through the site and see spectacular imagery and animations and details on the morphology of many representatives of the Earth's biota. Recent additions or updates to the site include:

New Probainognathian Cynodont, *Pseudotherium argentinus*
Wallace and coauthors recently described the skull of a new Triassic cynodont from the Ischigualasto Formation of Argentina. Their phylogenetic analysis suggests that *Pseudotherium*

More than 300 Publications Now Cite DigMorph

Did you know that more than 300 peer-reviewed data from DigMorph.org? Everything from comps to sabertooth cat evolution. And according to Google publications have been cited more than 8500 times! Here is a sampling of journal covers that DigMorph.org you can click here to see a full list of publications.

Moroccocystoides smithi, a New Cyclocystoid
Cyclocystoids are enigmatic extinct echinoderm morphology. Most specimens are known from Mid-Carboniferous rocks in Laurentia and Baltica. Ho coauthors recently reported a new species, *Moroccocystoides smithi*, from the Ordovician of Gondwana. These specimens are within concretions; HR/CT scanning makes it possible to produce positive digital casts. Learn more about this cyclocystoid account.

Three New Species of *Thorius*
In 2016, Parra-Olea and coauthors published the study of tiny salamanders from Oaxaca, Mexico, discovered in the 19th century, but populations dramatically in the last 30-35 years. It may, in fact, be an endangered genus of amphibians. In this study, the authors describe three new species and redescribe three existing ones. Learn more about these species and all five species can be found here on DigMorph.org.

***Spathorhynchus fossorium*, Fossil Amphibaenian**
Amphibaenians are enigmatic, limbless, fossorial tetrapods. Phylogenetic relationships are poorly understood and coauthors in the *Journal of Anatomy* examined the osteology of *Spathorhynchus fossorium*, the oldest known well-preserved amphibaenian, from the Eocene Green River Formation of Wyoming. This study suggests that some 'primitive' characters may in fact be derived. Learn more about this species and all five species can be found here on DigMorph.org.

MorphoSource BETA Enter search terms Q Go Media - Browse -

About Documentation - Resources -

Find, view, and download 3D data representing the world's natural history, cultural heritage, and scientific collections.

Data are contributed by museums, researchers, and scholars to share findings, increase impact, and improve access to material critical for scientific discovery and the advancement of human knowledge.

Want to find data? Browse categories

Want to contribute? Learn more

Welcome to the launch of MorphoSource 2.0! We are very excited to share the new and much improved version of the repository with you. You may find many differences compared to the previous version of MorphoSource. We have produced a [launch welcome video](#) to briefly cover major aspects of the new site, and a [3D viewer video](#) to overview features and functions of the 3D viewer. It is also possible that you may encounter bugs. We are working hard to address any issues, and you can help us by [reporting bugs](#) that you encounter.

NMDID New Mexico Decedent Image Database (NMDID)

The New Mexico Decedent Image Database provides researchers with access to whole human body computed tomography (CT) scans and a rich body of associated metadata.

Learn more »

ADVANTAGES OF VIRTUAL ANTHROPOLOGY

- 1) Non-destructive
- 2) Accessibility of all structures
- 3) Permanent availability of virtual objects
- 4) Accuracy and reproducibility of measurements
- 5) Possibility of obtaining information for advanced morphometric analysis
- 6) Easily shareable and storage

Why is *virtual anthropology* important for human identification?



75% of examinations in medical practice are imaging (Mettler 2014)

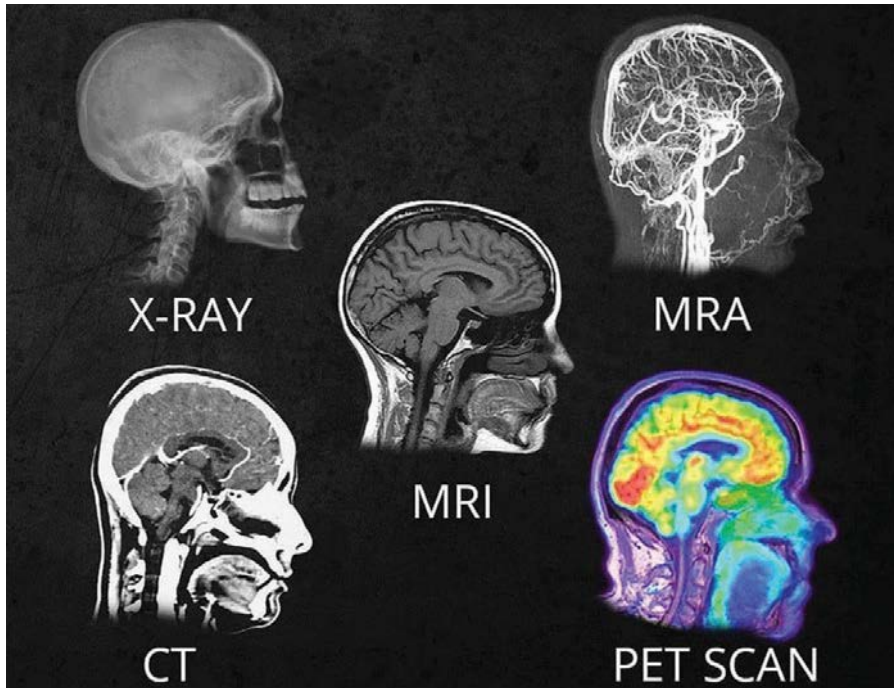


MES	ESTUDIOS SIMPLES	RESONANCIA	TOMOGRAFIA	Total
Enero	3,095	355	1,969	5,419
Febrero	3,511	386	1,670	5,567
Marzo	3,400	408	2,018	5,826
Abril	3,723	390	2,093	6,206
Mayo	4,648	450	2,081	7,179
Junio	4,052	489	1,948	6,489
Julio	3,542	527	2,311	6,380
Agosto	3,626	496	2,446	6,568
Septiembre	3,797	443	2,458	6,698
Octubre	3,619	519	2,810	6,948
Noviembre	3,131	413	2,460	6,004
Diciembre	2,494	374	2,209	5,077
				74,361

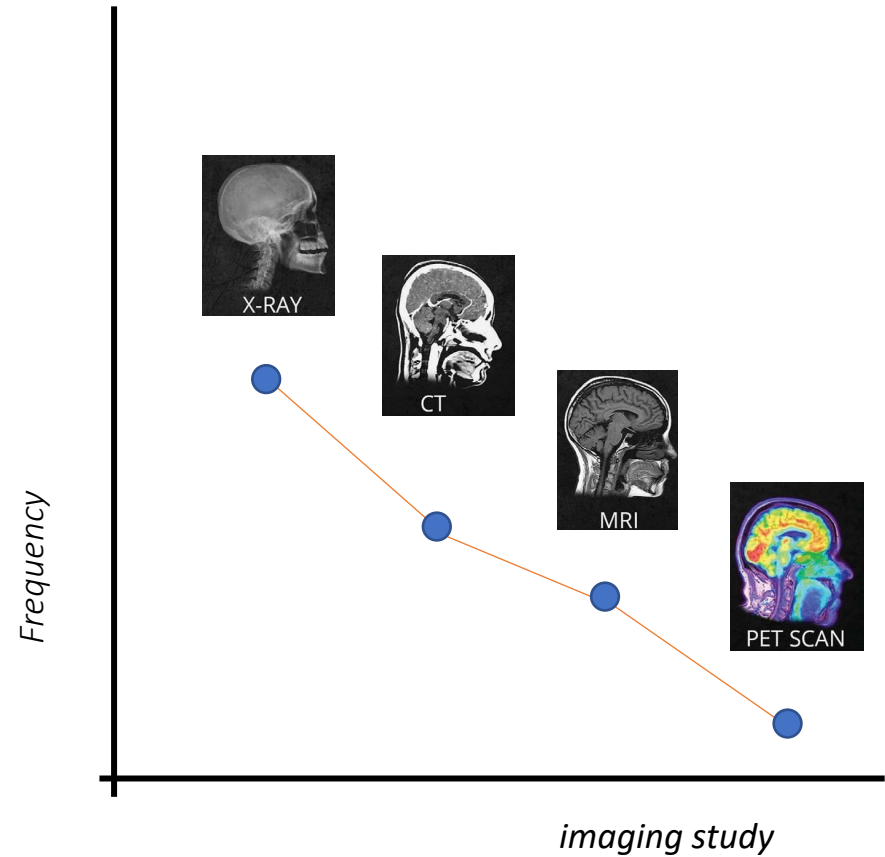


SOURCE OF COMPARISON

AM-PM



Previous data
Life story



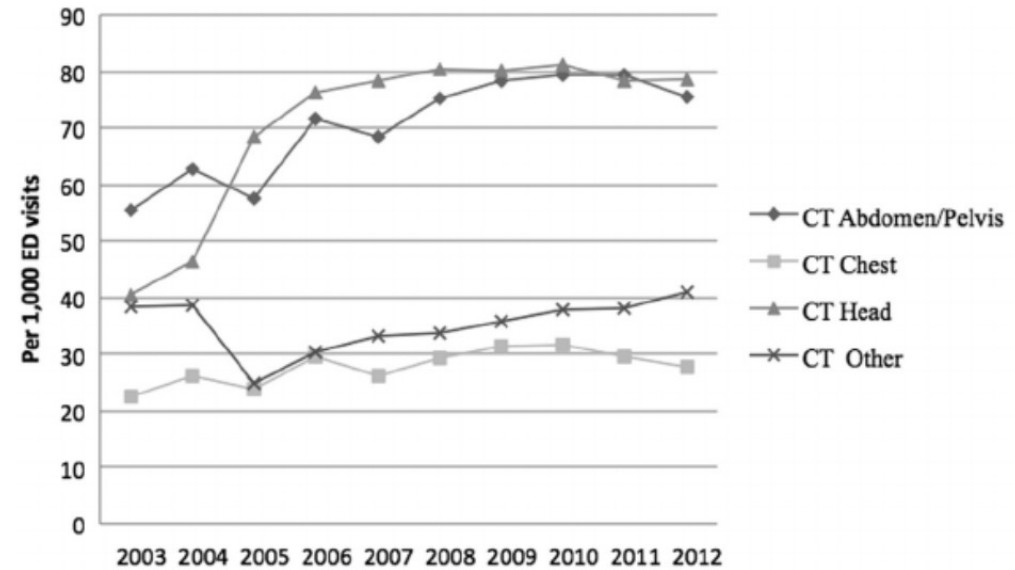
RESEARCH ARTICLE

Open Access



Access to primary care and computed tomography use in the emergency department

M. Fernanda Bellolio^{1,2,3*}, Shawna D. Bellew¹, Lindsey R. Sangaralingham^{2,3}, Ronna L. Campbell¹, Daniel Cabrera¹, Molly M. Jeffery^{1,2}, Nilay D. Shah^{2,3} and Erik P. Hess¹



CT Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CT Abdomen/Pelvis	55.4	62.8	57.7	71.7	68.6	75.3	78.3	79.2	79.2	75.6
CT Chest	22.5	26.2	23.8	29.7	26.2	29.2	31.3	31.6	29.6	27.8
CT Head	40.6	46.5	68.4	76.2	78.2	80.5	80.1	81.1	78.4	78.5
CT Other	38.4	38.8	24.8	30.3	33.1	33.7	35.7	37.9	38.2	40.9

Fig. 4 Trends in ED Computed Tomography Use by Year and CT type. CT imaging per 1000 ED visits, 2003 through 2012, stratified by CT type. CT Head had the highest utilization rate increase from 40.6 per 1000 ED visits in 2003 to 78.5 per 1000 ED visits in 2013

Human identification



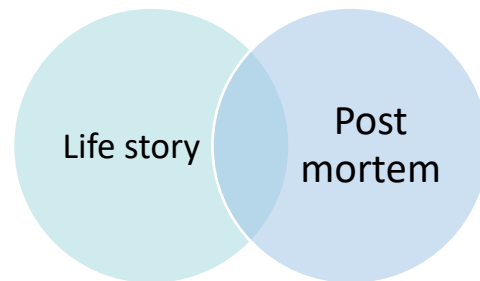
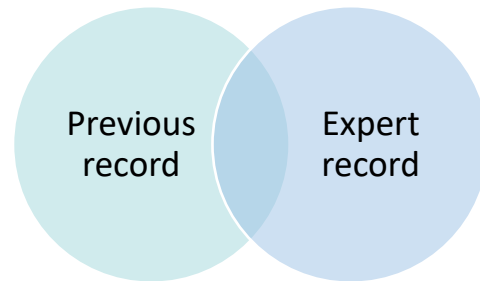
Alive persons



T
A
F
O
N
O
M
Í
A



Lifeless persons



Personal identification

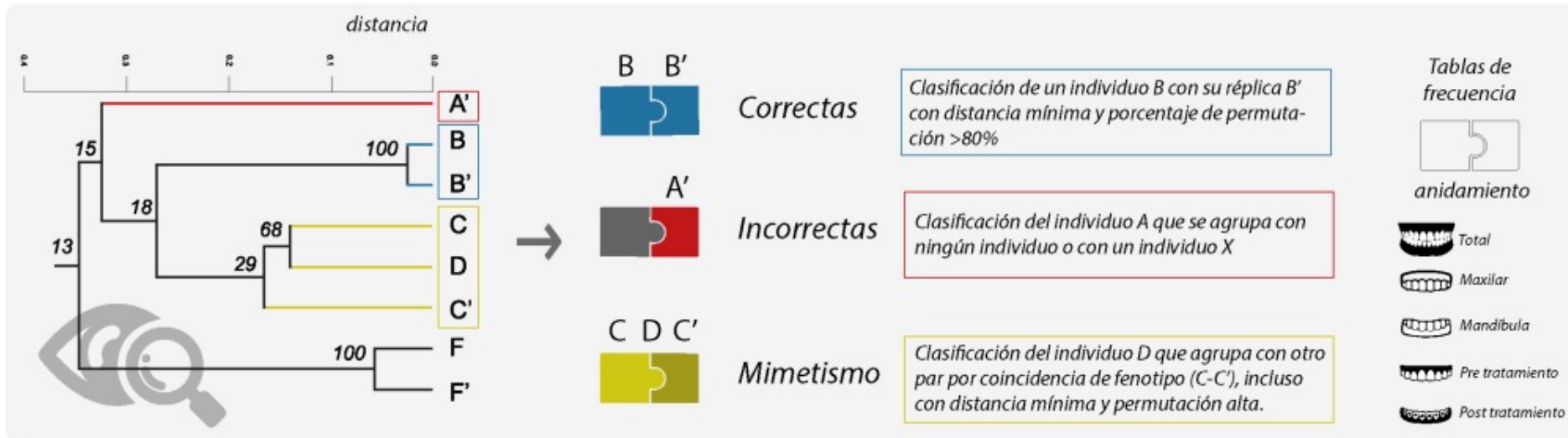


Similarity / dissimilarity pattern

Human identification

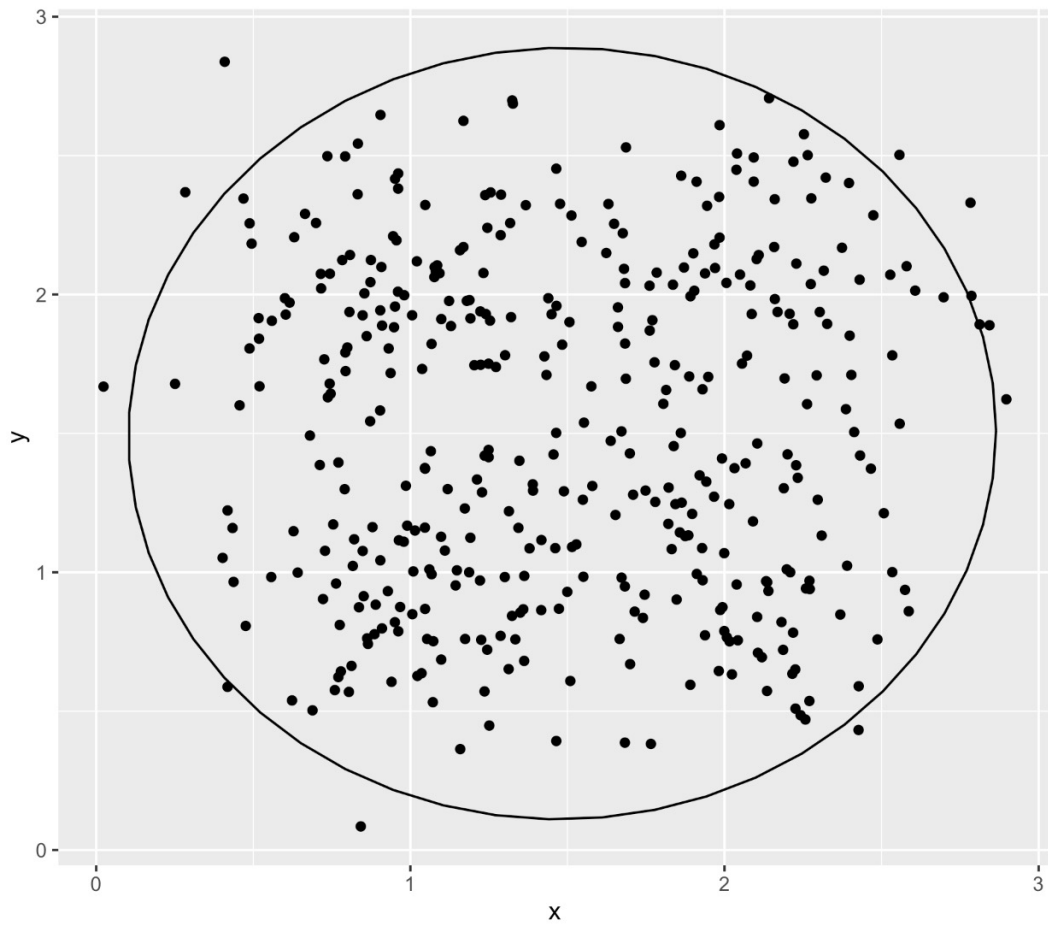


Creative Commons, attribution-NonCommercial 4.0 International (CC BY-NC), Laboratorio de Antropología y Odontología Forense, Ciencia Forense, UNAM



Creative Commons, attribution-NonCommercial 4.0 International (CC BY-NC), Laboratorio de Antropología y Odontología Forense, Ciencia Forense, UNAM

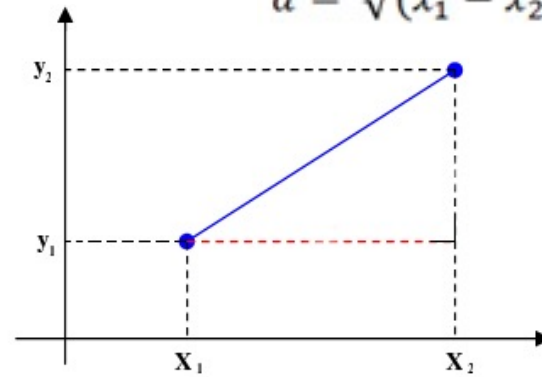
Human identification



Morphospace: phenotype

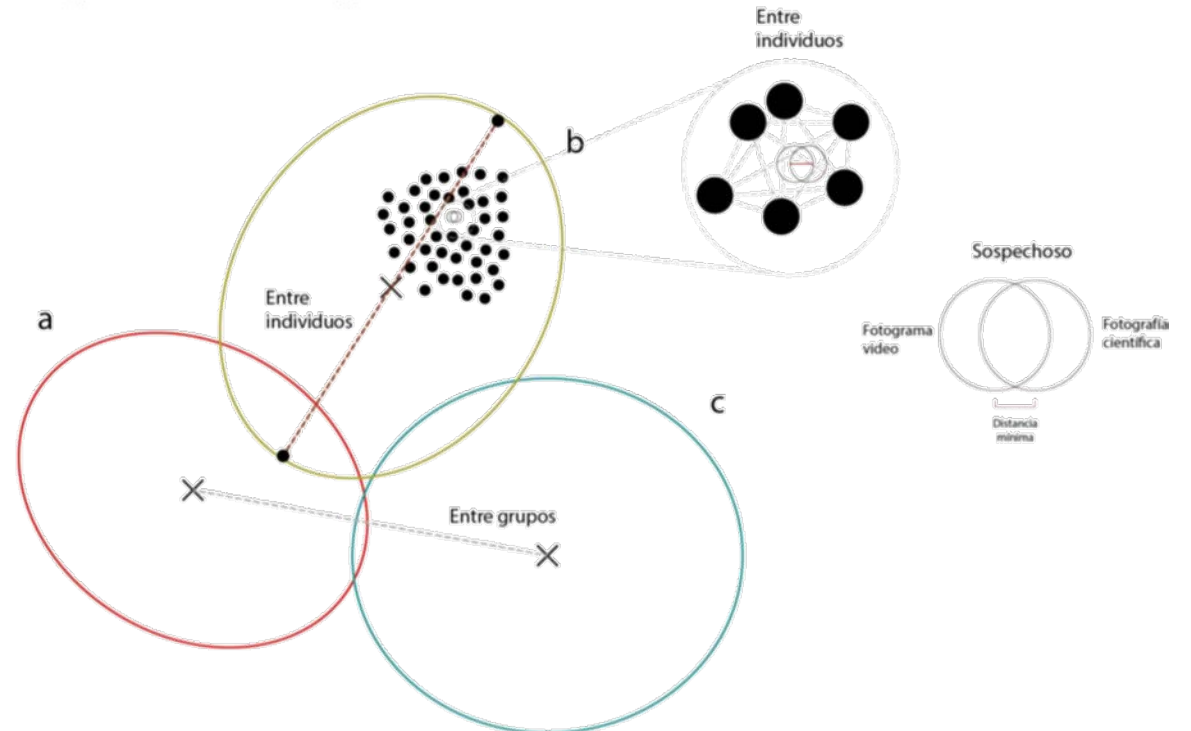
Distance between groups

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$



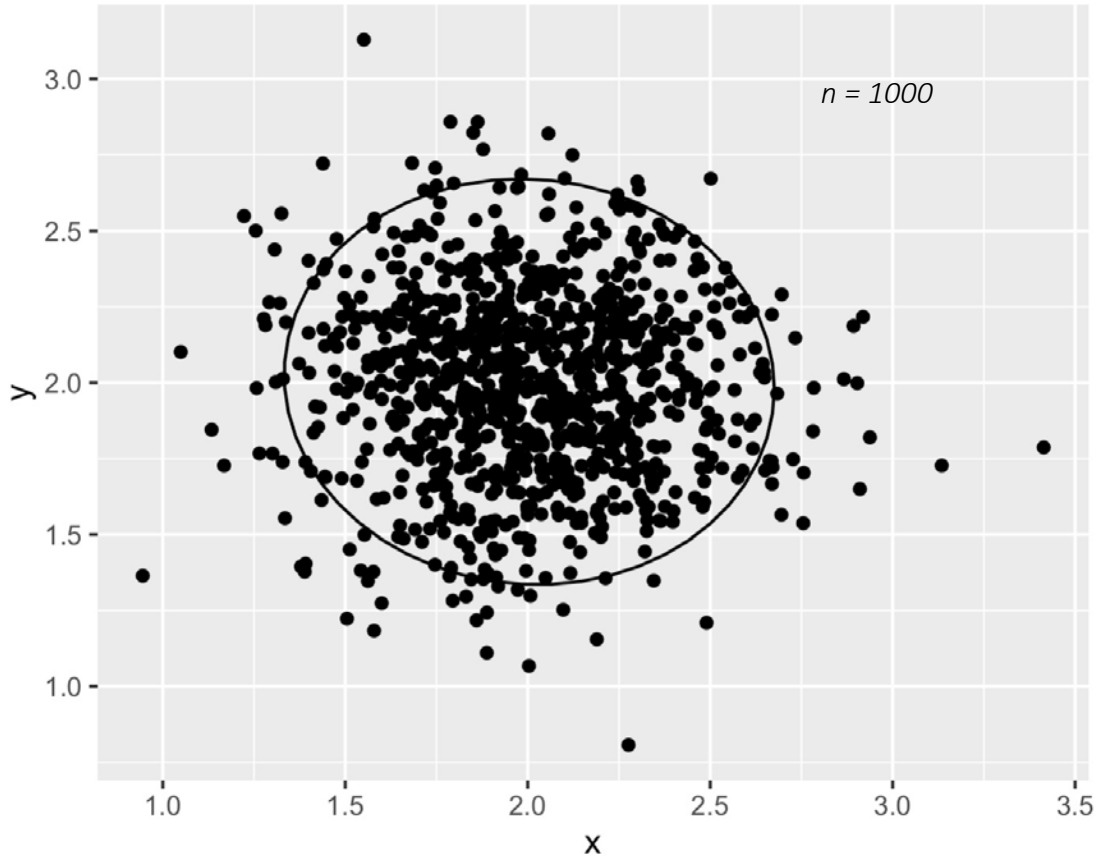
Distance Matrix

	A	B	C	D	E	F
A	0	16	47	72	77	79
B	16	0	37	57	65	66
C	47	37	0	40	30	35
D	72	57	40	0	31	23
E	77	65	30	31	0	10
F	79	66	35	23	10	0

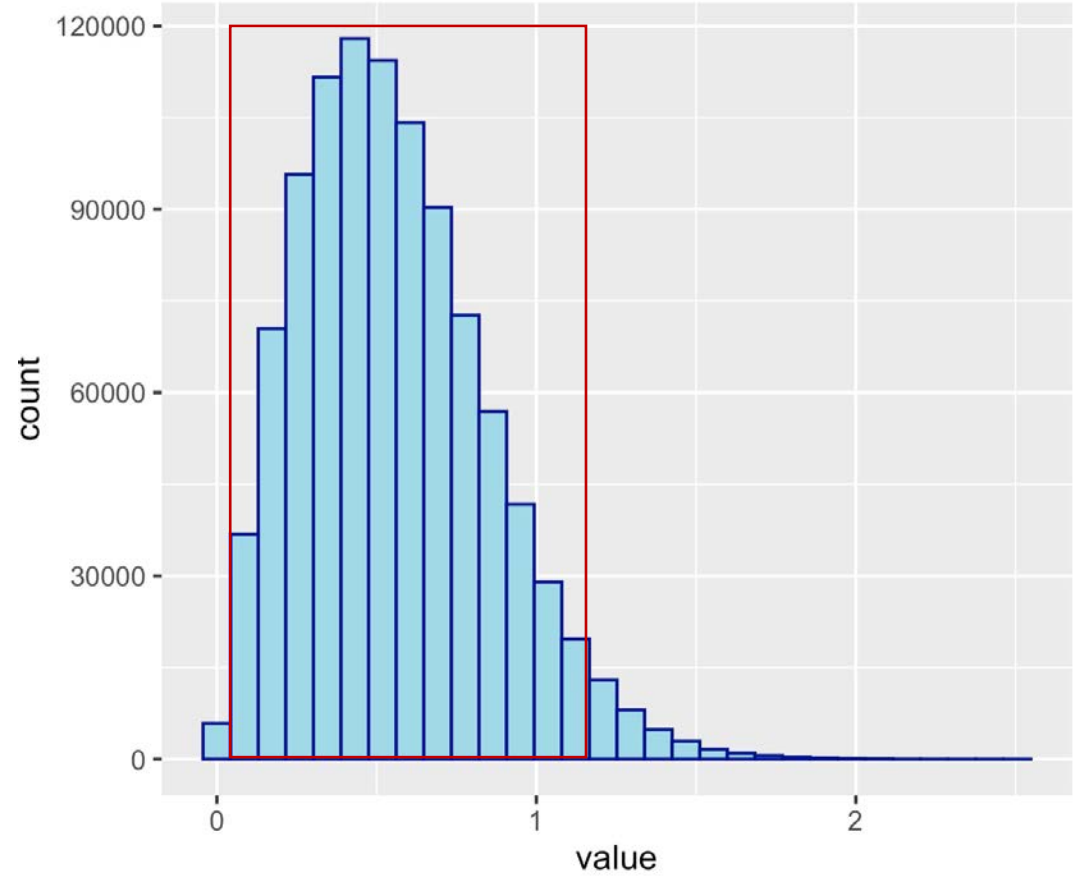


Human identification

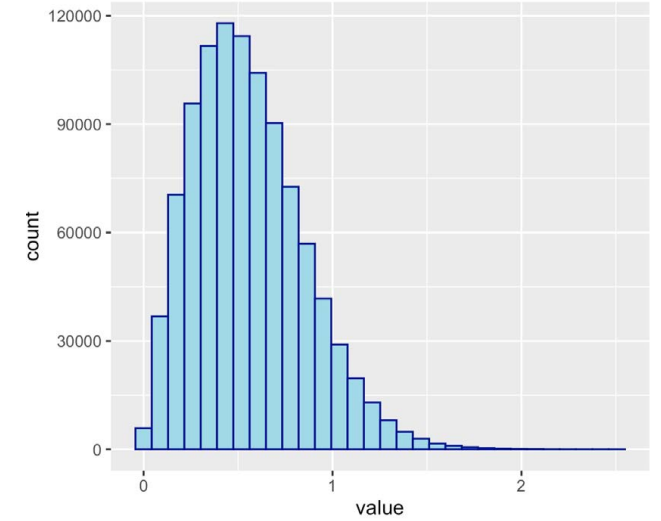
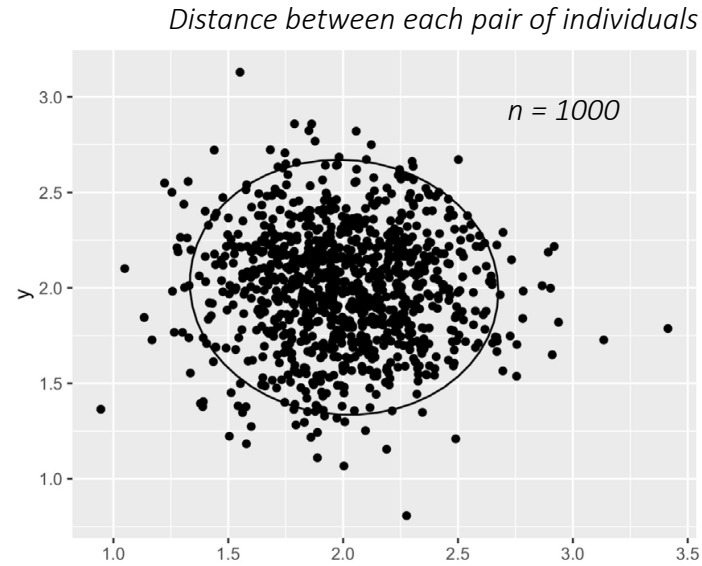
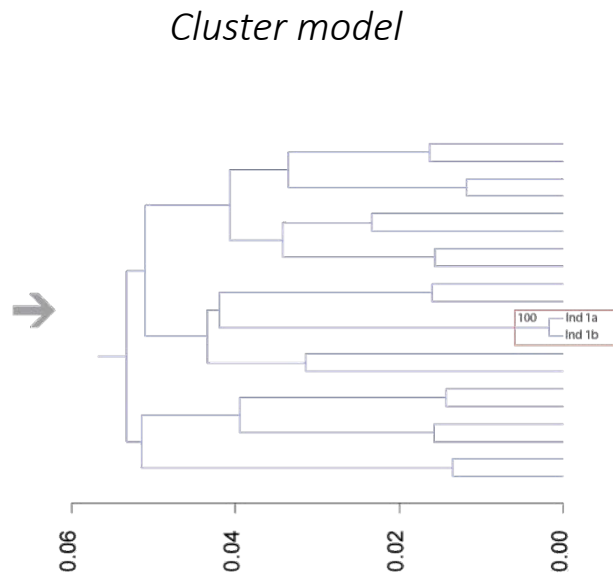
Distance between each pair of individuals



```
> summary(df4$value)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.0000  0.3351  0.5209  0.5555  0.7370  2.5046
```



Human identification



FORENSIC SCIENCES

J Forensic Sci. May 2011, Vol. 56, No. 3
doi: 10.1111/j.1556-4029.2011.01731.x
Available online at: onlinelibrary.wiley.com

PAPER
ODONTOLOGY

H. David Sheets,¹ Ph.D.; Peter J. Bush,² B.S.; Cynthia Brzozowski,³ D.M.D.;
Lillian A. Nawrocki,⁴ D.D.S., M.A.; Phyllis Ho,⁵ D.D.S.; and Mary A. Bush,² D.D.S.

Dental Shape Match Rates in Selected
and Orthodontically Treated Populations in
New York State: A Two-dimensional Study*

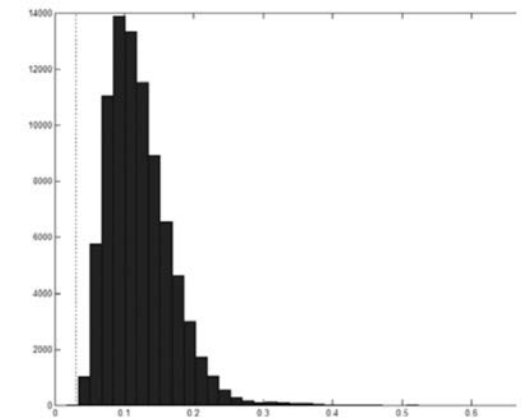
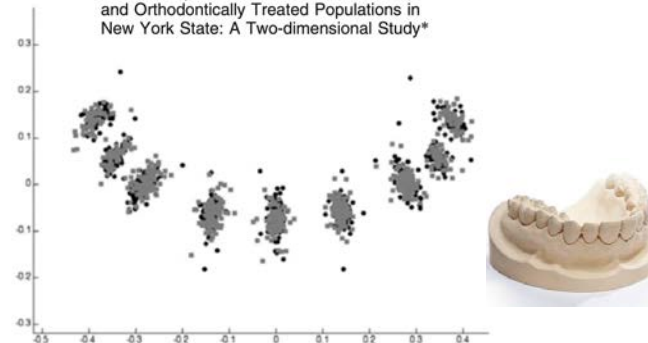


FIG. 2—Procrustes plot showing results of a bootstrapped F test (testing the utility of our statistical method) revealing that the male and female data sets in general closely overlap.

FIG. 3—Histogram of distribution of the Procrustes distance in the 410 mandibular dentitions. The x-axis on the histogram is a measure of similarity, with most similar dentitions to the left, and less similar to the right. The vertical line is our measurement error threshold. Clearly, as our error worsens and the line moves to the right, more dentitions would be considered a match.

Human identification

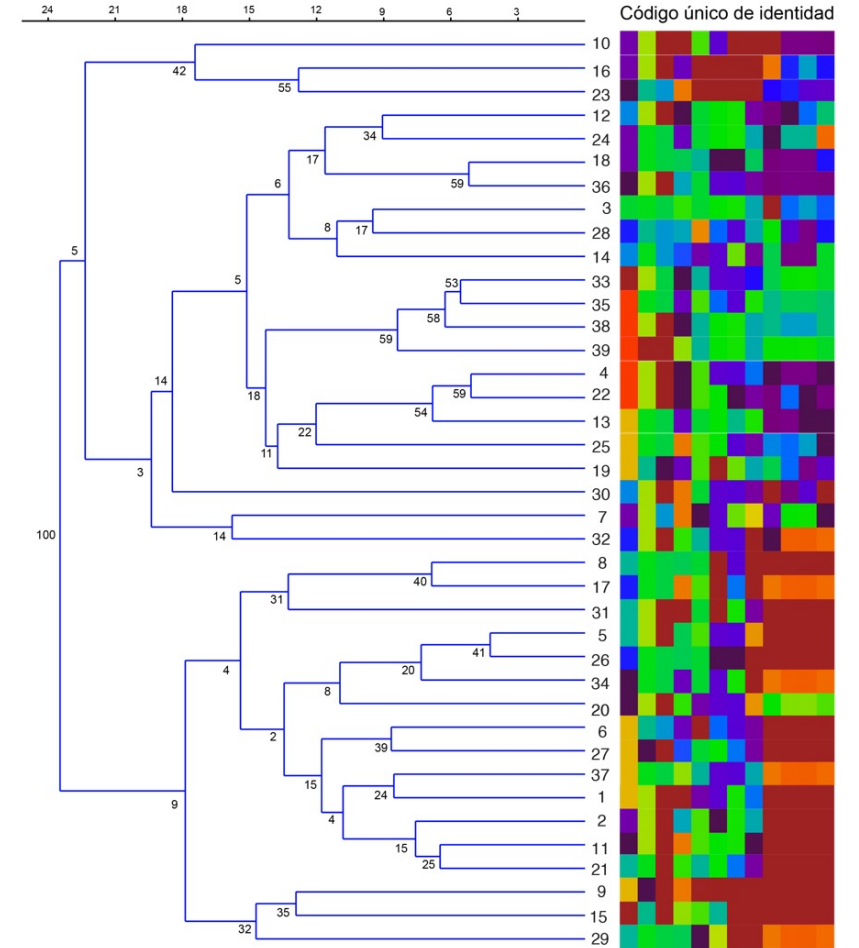
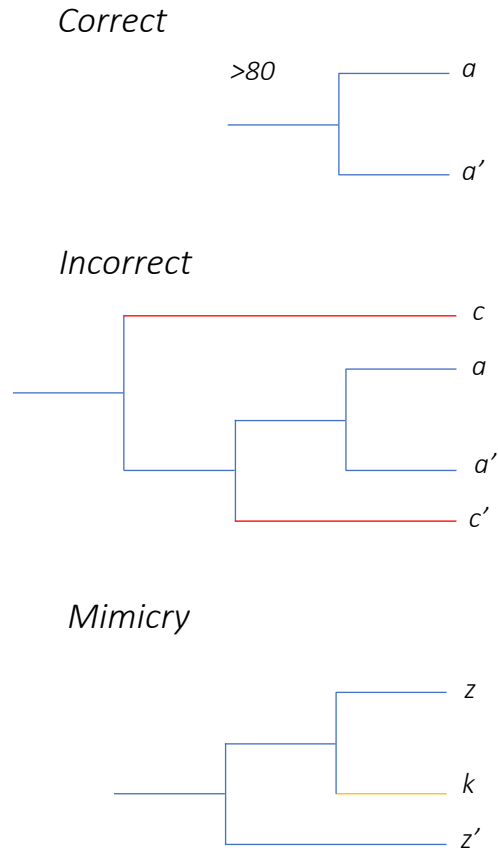
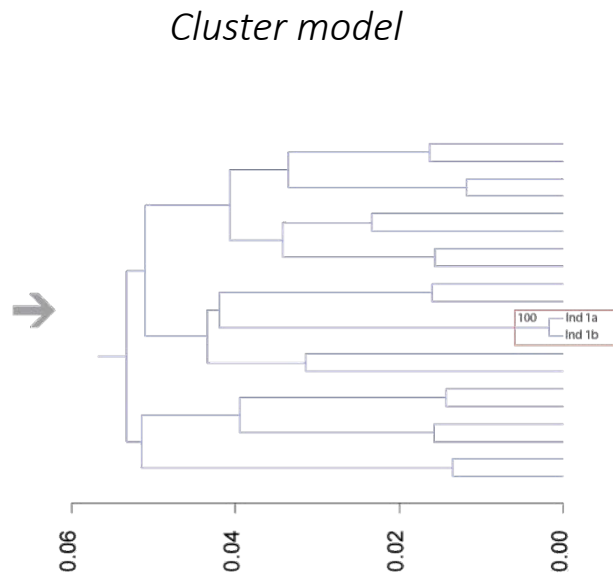
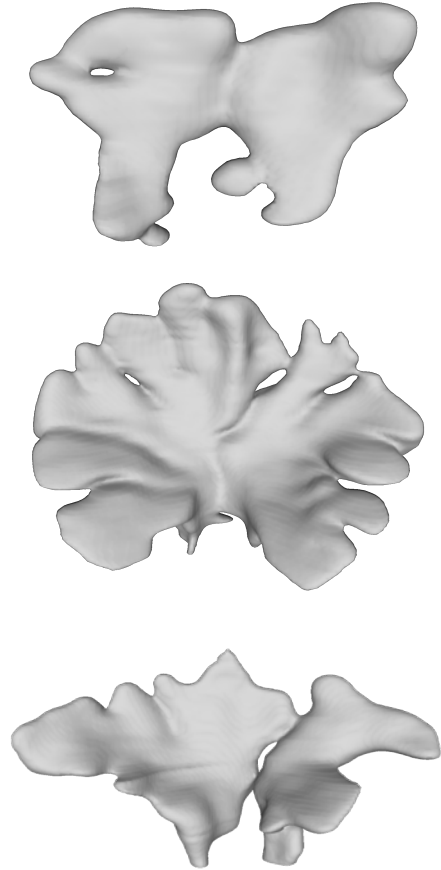
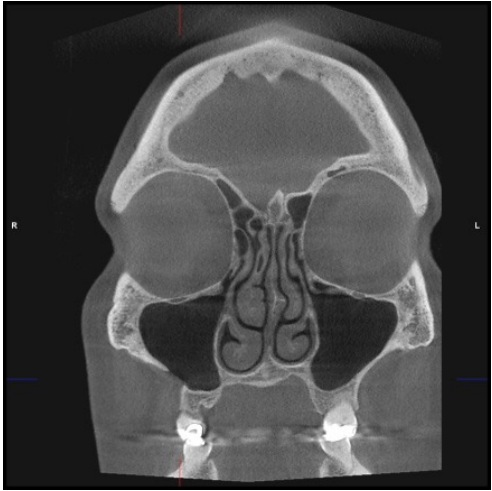


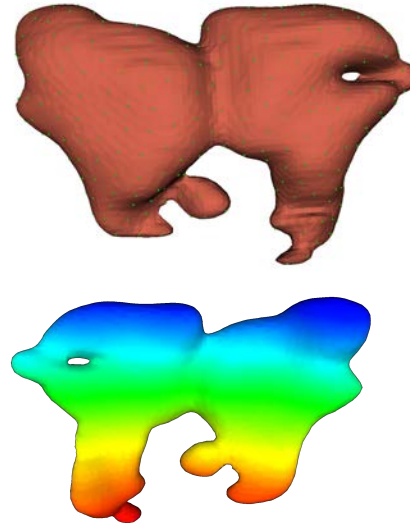
Fig. 4. Clúster de agrupación por patrón craneal en los individuos estudiados.

Human identification

Phenotype

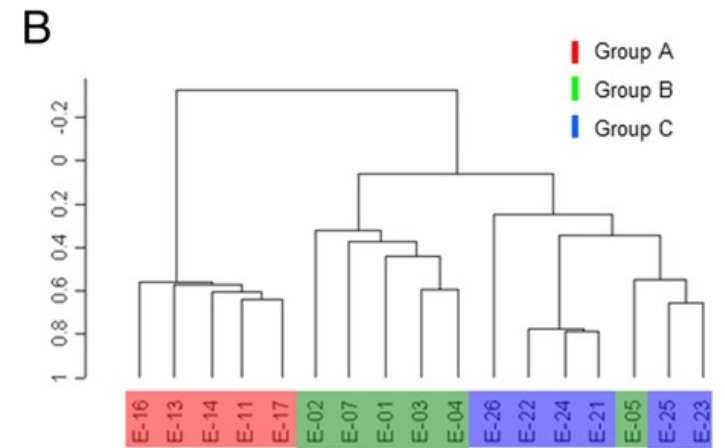
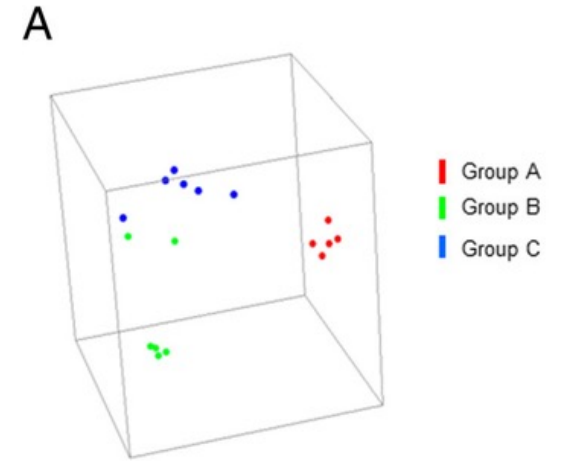


Variation



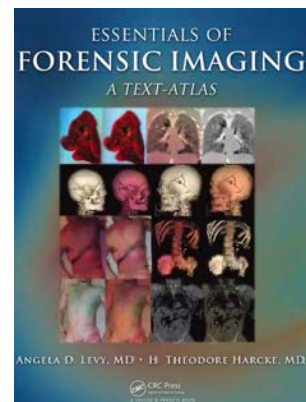
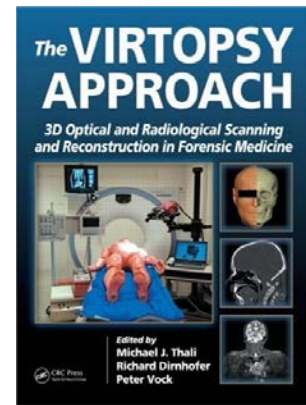
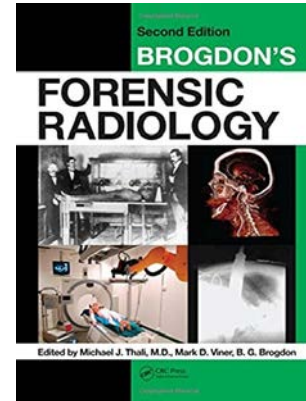
Data quality

Comparison



Identification

Evidence based human identification



TECHNICAL NOTE
 ANTHROPOLOGY

Masuko Ishii,¹ M.Sc.; Kazuhiro Yayama,^{2,3} V.M.; Hisako Motani,⁴ D.D.S., Ph.D.; Ayaka Sakuma,⁴ D.D.S.; Daisuke Yasjima,⁴ M.D., Ph.D.; Mutumi Hayakawa,⁴ M.D., Ph.D.; Seiji Yamamoto,⁵ M.D., Ph.D.; and Hirotaro Iwase,⁴ M.D., Ph.D.

Application of Superimposition-Based Personal Identification Using Skull Computed Tomography Images

* Models
 FSI-5002; No of Pages 11

ARTICLE IN PRESS



Available online at www.sciencedirect.com
 ScienceDirect



Forensic Science International xxx (2006) xxx-xxx
www.elsevier.com/locate/forensic

Use of multislice computed tomography in disaster victim identification—Advantages and limitations

Martin Sidler^a, Christian Jackowski^{a,*}, Richard Dirnhofer^a, Peter Vock^b, Michael Thali^{a,b}

^a Institute of Forensic Medicine, University of Bern, Buehlstrasse 20, CH-3012 Bern, Switzerland
^b Institute of Diagnostic Radiology, Inselspital, CH-3010 Bern, Switzerland
 Received 18 January 2006; received in revised form 4 June 2006; accepted 7 August 2006

CASE REPORT

A Case of Personal Identification Via Postmortem Computed Tomography Confirmation of Aphakic Eyes

Toru Oshima, MD, PhD,* Hiroshi Yoshikawa, MD, PhD,† Takeshi Yoshitomi, MD, PhD,‡ Maki Ohtani, DDS, PhD,* and Sohtaro Mimasaka, MD, PhD*

Journal of Forensic and Legal Medicine 36 (2015) 63–69



Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/jflm

Original communication

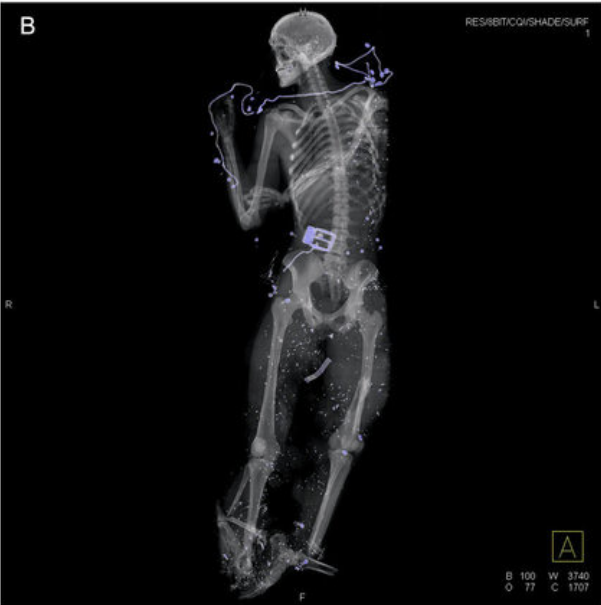
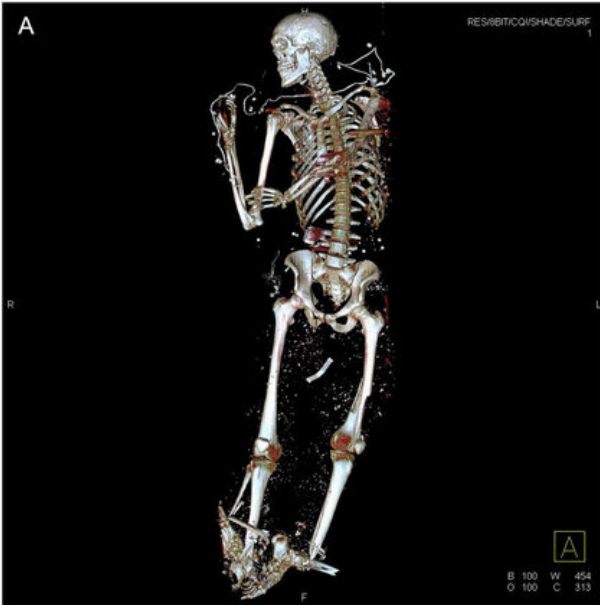
Human identification through frontal sinus 3D superimposition: Pilot study with Cone Beam Computer Tomography

Thiago Leite Beaini^{a,*}, Eduardo F. Duailibi-Neto^b, Israel Chilvarquer^c, Rodolfo F.H. Melani^d

^a Anthropology and Legal Dentistry Laboratory of the University of São Paulo, Av. Prof. Lineu Prestes, 2227, Postal Code (CEP) 05508-000, São Paulo, SP, Brazil
^b University of São Paulo Dental School, Brazil
^c Radiology, Department of the University of São Paulo Dental School, Brazil
^d Legal Dentistry, Department of the University of São Paulo Dental School, Brazil



Forensic imaging: Virtopsy-DVI



Forensic imaging: migration crisis databases



MAPA DE RIESGOS

La Comisión Nacional de los Derechos Humanos especificó en su Informe Especial sobre Casos de Secuestro de Migrantes en México los sitios en los que se corre peligro de ser víctimas de la delincuencia organizada



 New Mexico Decedent Image Database (NMDID) University of New Mexico

The New Mexico Decedent Image Database provides researchers with access to whole human body computed tomography (CT) scans and a rich body of associated metadata.

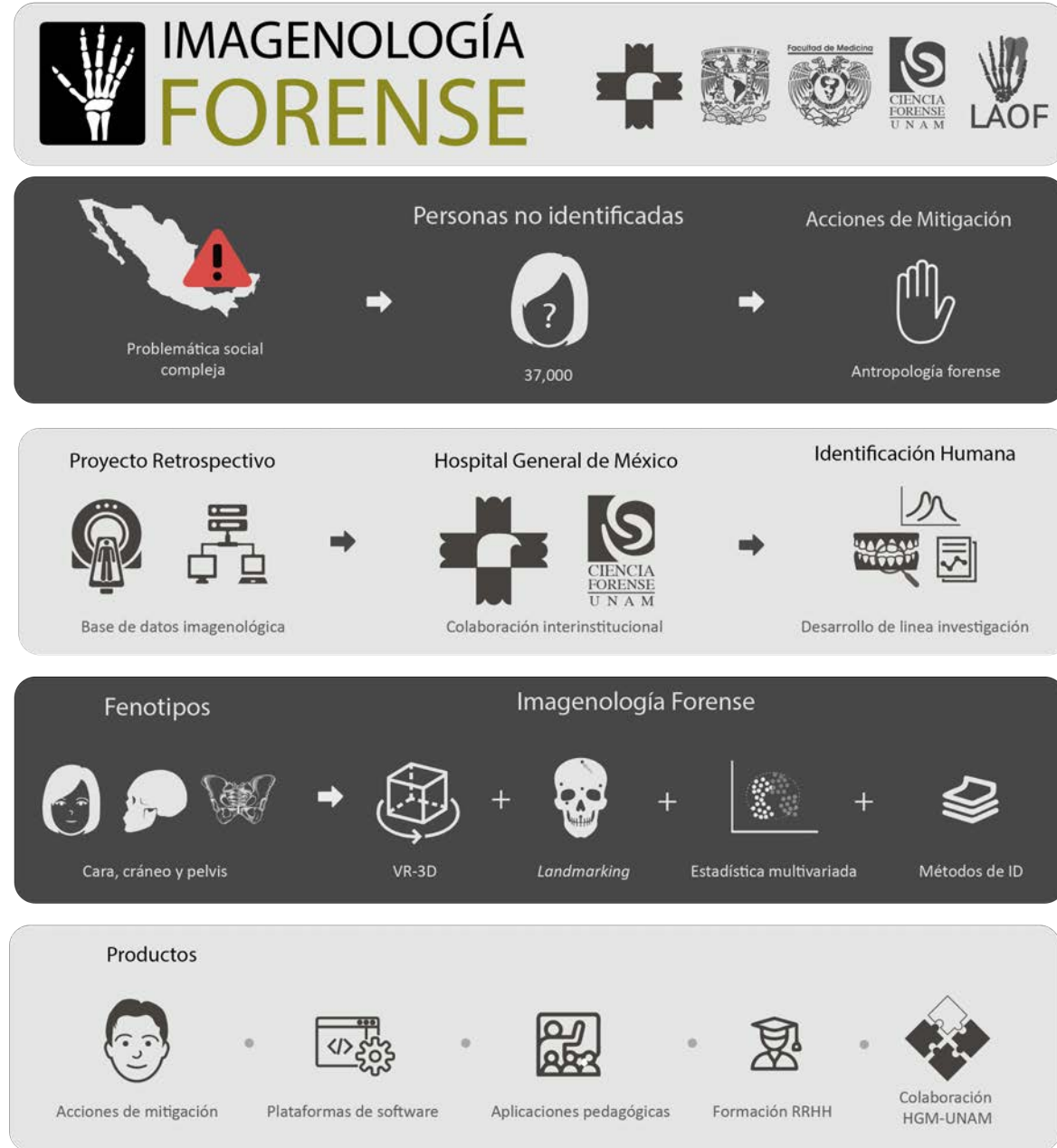
[Learn more »](#)


New Mexico Decedent Image Database

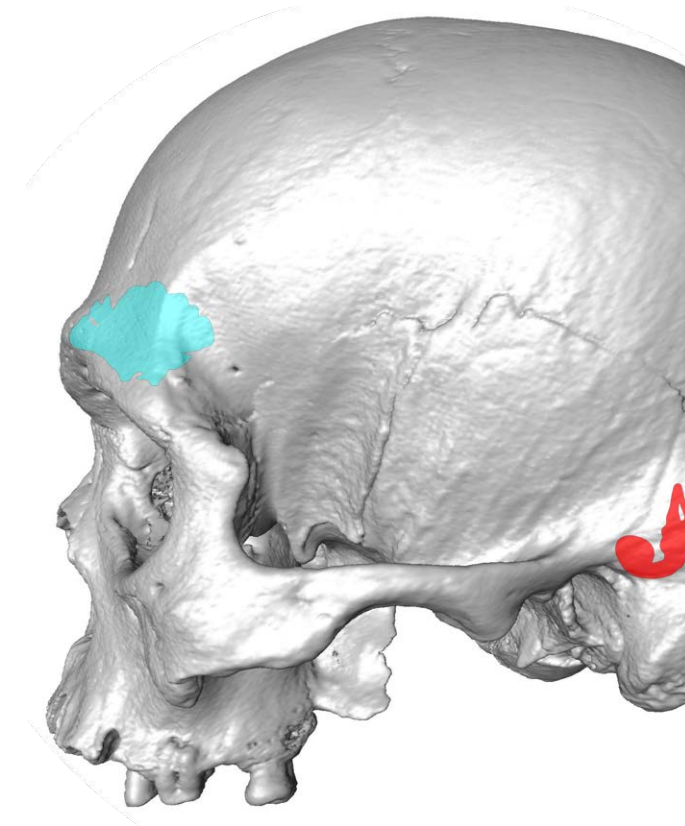
Proyectos previos



Figura 13. Propuesta para la macro-regionalización de la variación craneofacial mexicana en región Norte, Centro y Sur, en la estimación de ancestría biogeográfica.



Thank you!
Vielen Dank!
¡Gracias!



mexhumanid@gmail.com



@mexhumanid



Deutscher Akademischer Austauschdienst
German Academic Exchange Service

