INTERNATIONAL CONFERENCE IN CRANIOFACIAL SUPERIMPOSITION (ICCFS-2014)

MEPROCS

DUNDEE (UK), 30 JUNE-4 JULY 2014

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WELCOME BY THE PROJECT COORDINATOR

The "new methodologies and protocols of forensic identification by craniofacial superimposition" (MEPROCS) project started in February 2011. MEPROCS aimed to propose a common European framework to allow the extensive application of the craniofacial superimposition (CFS) technique in practical forensic identification scenarios commonly tackled by the European scientific police units.

From the very beginning, all the coordinating team at the European Centre for Soft Computing (ECSC) was aware of the MEPROCS challenge. We all were convinced that we could only succeed working hard. I would like to thank all my team at the ECSC for their strong support and enthusiasm during the whole project. In particular, I do appreciate the tireless work of my good friend and right-hand man in the project, Oscar Ibañez who was crucial for most of the MEPROCS tasks.

Beyond my institution, I am really impressed by the willingness to collaborate of the majority of the Forensic Anthropology community. Even though our final goal was the standardization of a controversial forensic identification technique, I always found words of support and tough work by my side. This positive attitude was not just by our great full-partners in MEPROCS (who were committed to the project) but also by our associated partners, supporting institutions, international associations and other institutions and companies.

Among them, my strongest gratitude is for the invaluable collaboration of Prof. Caroline Wilkinson at CAHID (Dundee). She provided an incredible help in many technical aspects of the project. Furthermore, she was open to lead the organizing committee of the International Conference on Craniofacial Superimposition (ICCFS-2014) in Dundee which is the last and most important MEPROCS event.

The ICCFS-2014 technical program is rich and varied. I am honored to count on the collaboration of two keynote speakers renowned world-wide. Right after the conference, the presentation of the hand-book of craniofacial superimposition aims to summarize the most important achievements of the MEPROCS project. Finally, the practitioners have a unique opportunity to receive a diverse and high-quality training on craniofacial superimposition including the approaches of different labs all around the world.

I hope that you enjoy these days.

Sergio Damas
MEPROCS Coordinator
ICCFS2014 Conference Chairman
Principal Researcher
European Centre for Soft Computing

European Centre for Soft Computing

WELCOME BY THE ORGANIZING COMMITTEE

Welcome to Scotland and the University of Dundee from the organizing committee.

This conference is the final dissemination event for the MEPROCS European Research Consortium and has two clear aims:

- to provide an opportunity for practitioners from around the world to meet and discuss academic issues relevant to craniofacial superimposition
- to provide training and knowledge transfer to support craniofacial superimposition practitioners

This event is significant for the field and is the first time that there has been an international meeting dedicated to craniofacial superimposition.

Whilst you are here in Dundee you will be able to visit the Centre for Anatomy & Human Identification, which received a 2013 Queen's Anniversary Award for its pioneering research and teaching in relation to forensic anthropology, craniofacial identification and human anatomy.

Dundee is known as Scotland's student city, with the highest proportion of young people in fulltime higher education than any other, Dundee enjoys more hours of sunshine, better air quality and more green spaces than any other Scottish city. The University location in the city centre offers the best of all worlds - a compact, friendly campus with an unrivalled position in the heart of the city's West End, close to shops, bars, restaurants, with stunning views of the Tay and the north Fife coastline.

I hope you have a wonderful week in Dundee.

Professor Caroline Wilkinson
ICCFS2014 Organizing Committee
Professor of Craniofacial Identification
Centre for Anatomy & Human Identification
University of Dundee

THE QUEEN'S ANNIVERSARY PRIZES
FOR HIGHER AND FURTHER EDUCATION 2013

The ICCFS2014 Organizing Committee:

Institution	Name	Institution	Name
University of Dundee, UK:	Caroline Wilkinson Caroline Erolin	University of Coimbra, Portugal:	Eugenia Cunha Paula Lopes
European Centre for Soft Computing, Spain:	Sergio Damas Oscar Ibáñez Carolina Jiménez Carmen Peña Roberto Morán Laura Roces	Israel National Police, Israel:	Tzipi Kahana
		CORISA, Italy:	Mario Veniero

CONFERENCE PROGRAMME

Monday 30 June 2014

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Oral Presentations

CFS Methods (M1-M10)

M1: *"Comparative Characteristics of dioptograf, photo, video, radiographs and 3D modelling, as an object for photo superimposition"*. D. Vakhmyanina, A. Abramov, E. Veselovskaya, G. Pozdneev, A Rassazova.

M2: *"Using the method of scaling by image of iris for craniofacial identification"*. D. Zolotenkov.

M3: *"Variation of superimposition algorithm in craniofacial identification"*. G. Pozdeev, E. Veselovkaya, A. Abramov, A. Rasskazova.

M4: "*Creating a ground-truth craniofacial superimposition database"*. A.Valsecchi, O. Ibáñez, F. Cavalli, B.R. Campomanes-Alvarez, C. Campomanes-Alvarez, M.I.Huete.

M5: *"Modeling the skull-face overlay uncertainty using soft computing and computer vision"*. B.R. Campomanes-Alvarez, O. Ibáñez, S. Damas, O. Cordón.
M6: *"Skull-photo superimposition: Criteria for overlaying and assessing exclusions"*. P.T. Jayaprakash.

M7: *"Craniofacial superimposition evaluation with a shape matching algorithm: a study"*. L. Lusnig, F. Cavalli.

M8: "*Dental Information in cranio-facial superimposition: the MEPROCS experience and an overview of cases from Victoria, Australia"*. R. Hardiman, J. Clement.

M9: "*The use of craniofacial superimposition for Disaster Victim Identification"*. C. Wilkinson, A. Tilottson

M10: "*2D & 3D Superimposition used in facial comparison of Female-to-Male Transsexuals"*. S. Mackenzie, C. Wilkinson

Skull and face relationship (R1-R4)

R1: "*Eye fissure dimensions prediction by means of eye-pit dimensions measurement"*. A. Rasskazova, E. Veselovkaya

R2: "*Whitnall's tubercle – exocanthion relationship based on craniofacial superimposition images"*. H. Hadi, Paul Jayaprakash

R3: *"Contribution of the golden ratio and craniometric indices to craniofacial superimposition - Study in a Brazilian sample"*. P. Almeida Prado, L. Brito, Mario Fernandes, Margarida Szabo, Michel corsato, Rogério Oliveira.

R4: *"Application of the new methods in Craniofacial Superimposition"*. M. García Corro, U. Pigolkin, A. Mosoyan

Case studies (C1-C3)

C1: *"Identification of KGB victims (1944-1947) mass grave site in Vilnius, Lithuania".* J. Jankauskas, S. Abrutis

C2: *"Anthropology and genetics go together. Practical case: identification of human remains in a group burial".* M. Ignashkin, S. Frolova, A. Abramov, A. Komarova, N. Romanko, A. Dolgov

C3: *"The craniofacial superimposition in art: the case of the church of St. Catherine of Pasian di Prato (Udine)".* F. Cavalli

Face and skull anthropometry (A1-A3)

A1:*"When you're smilin': the role of different expressions in modifying facial 3d morphology".* D. Gibelli, D. de Angelis, C. Sforza, C. Cattaneo

A2: *"Three-dimensional analysis on face shape variation and aging-induced changes in Japanese population".* K. Imaizumi, Y. Ogawa, K. Taniguchi

A3:*" Typology of faces as a source of data for the craniofacial identification".* D. Veselkova

Poster Session

CFS methods (P1-P5)

P1: *"An Application of an Automatic Skull Fragment Reconstruction Method to obtain 3D Skull Models for Craniofacial Superimposition".* E. Bermejo, O. Cordón, S. Damas, A. León, I. Alemán, O. Ibañez

P2: *"Fuzzy Spatial Reasoning applied to Craniofacial Superimposition".* C. Campomanes, O. Ibañez, O. Cordón, C. Wilkinson

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P4: *"Automated Facial Recognition of Craniofacial Reconstruction Models".* C. Rynn, C. Wilkinson

P5: *"Face off - In vivo facial soft tissue depth for German adults".* N. Thiemann, V. Keil, U. Roy

CFS case studies (P6-P9)

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P7**:** *"Craniofacial superimposition in the identification of Adam Muchtin – a priest on his way to beatification"*. A. Petaros

P8: *"Craniofacial superimposition: four case studies from South Africa"***.** M. Steyn, T.M. Briers

Ethical and legal issues in CFS (P9-P11)

P9: *"Ethical and Legal issues in CranioFacial Superimposition"*. S. Kumar Dhattarwal, P. Chhikara, R. Sharma

P10: *"Ethical and Legal Issues in forensic anthropology: from craniofacial superimposition to identification of the living"*. M. Silvestre, C. Cattaneo, D.H. Ubelaker, D. Vieira.

P11: *"Ethical and legal considerations involved in the study of human skeletal remains for investigative purposes: Craniofacial Superimposition"*. M.I. Huete

Face and skull anthropometry (P12-P15)

P12**:** *"Automatic cephalometric landmarks estimation in Cone Beam CT"*. M.Codari

P13: *"Marking constant points on the faces in different projections. Truth and Lies"*.
N. Gridina

P14: *"Variations of midfacial soft tissue thickness in subjects aged between 6 and 18 years for the reconstruction of the profile: a study on an Italian sample"*. F. Collini, D, M. Gibelli, C. Sforza, C. Cattaneo

P15: *"Constant points and anatomical landmarks in craniofacial identification"*. A. Abramov, E. Veselovkaya, A. Zinin, A. Rasskazova, A. Komarova

Monday 30 june 2014/ 9:30-10:30: Key note

Dr. Douglas Ubelaker

Photograph courtesy of Smithsonian Institution Archives, 2002-15888.

Dr. Douglas H. Ubelaker is a curator and senior scientist at the Smithsonian Institution's National Museum of Natural History. He has published extensively in the general field of human skeletal biology with an emphasis on forensic applications. As a youth, Doug went to the University of Kansas to study medicine. He became interested in anthropology after taking a class and doing summer fieldwork with Professor William Bass. The field experience opened his eyes to the valuable stories that can be found from sites contained human remains, and Doug went on to get his PhD in anthropology.

Doug joined the Smithsonian in 1971, following in the footsteps of his predecessor Dr. Larry Angel and Dr. T. Dale Stewart. Doug also became an expert consultant to the FBI to help solve criminal cases. During his career, he has reported on more than 900 cases and testified in many legal proceedings, including the famous Waco, Texas case. His research includes assembling a database of skull and skeletal measurements for Latin American remains, studying the bio-archaeology of Roman tombs, improving methodology in forensic anthropology, and looking at geographic skeletal variation in ancient Ecuador. He is Past President of the American Academy of Forensic Sciences and continues to take an interest in the policies and practices that shape forensic science.

Craniofacial Superimposition: History and Current Issues.

The history of craniofacial superimposition includes advancements in both technology and the nature of applications. While this methodology can be utilized successfully for exclusion, its use in the identification process is more problematic. Research is needed to concentrate not only on continued technological progress but also on the central probability issues related to identification. This presentation focuses on key historical developments as well as current research priorities.

Comparative characteristics of dioptograf, photo, video, radiographs and 3D modeling, as an object for photo superimposition

D. Vakhmyanina[1], A.. Abramov[2], E. Veselovskaya[2], G. Pozdneev[3], A Rassazova[3]

[1]*Main Department of Criminalistics Investigation. Committee of Russia*
[2]*Biomedical Department of the General Directorate of Criminalistics of The Investigative Committee of Russia Federation*
[3]*Institute of Ethnology and Anthropology of the Russian Academy of Sciences*

Identifying a person, we use various methods of photo, video and other superimpositions. Each method has its own practical use. This research is dedicate for finding errors in combinations, designating the most exact method of identification, taking into account the distance 50/150/300sm in photo and movie shooting.

During the research 6 experiments of photo, video, dioptograf, radiographs and 3D models have been carried out for defining the criteria of graphic craniofacial reconstruction and person identification by means of superimposition method.

Having carried out the analysis, we have established, that the most effective method of superimposition at the distance of 100-150sm, as it has less perspective distortions. The result of radiographs have turned out less productive.

Using the method of scaling by image of iris for craniofacial identification.

D. Zolotenkov
First Moscow State Medical University

The present scientific work is dedicated to the theme of using the image of a human face on a photography in score of determining its sized characteristics. This theme seems to be interesting for us because the comparison of proportions of a face or a scalp doesn't always give us full understanding of interrelations. We used the image of iris for sizing up face parts.

Considering that the human iris horizontal diameter is a constant magnitude and it is about 11,8 mm we can calculate other parts of a face. The accuracy of calculating depends on the quality of a photo or video and on foreshortening of a face. The following method is acceptable only in the case the verse diameter of iris can be measured.

According to our assumptions, using calculations with proportions, we can measure any fragment of externality. In our practice we used the graphics redactor "Photoshop CS2" and photos of faces of 8 volunteers (4 male, 4 female), made in equal conditions. At first we marked the horizontal diameter of iris and it's size in pixels. With this data, we can receive the value in millimeters for eny fragment of a face, if we know its value in pixels. Comparing received data with real anthropological information, we detected series of terms and restrictions on using this method. The comparison of mistake probability in determining the sizes of face fragments in maximum or minimum variations in population gives us the right to count the conducted work useful.

Present approach let us proceed to absolute values such as width of the forehead, length of the nose etc. Using this data let us find new techniques in craniofacial identification.

Variation of superimposition algorithm in craniofacial identification.

G.Pozdeev[1], E. Veselovkaya[2], A. Aramov[2], A. Rasskazova[1]

[1] *Institute of Ethnology and Anthropology of the Russian Academy of Sciences*
[2] *Biomedical Department of the General Directorate of Criminalistics of The Investigative Committee of Russia Federation*

The article is about the search of optimal algorithms for the craniofacial superimposition.

In this study, we used 12 photos of 6 males and 6 females and also 12 3D models of skulls, which knowingly don't belong to these persons.

We took notice that different investigators estimated negative results of comparison differently. From our viewpoint it is caused by a distinction in the comparison algorithms.
Use the below algorithm photo-skull superimposition allowed us to draw attention to the following points.

During the analysis, we estimating the role of the landmarks and of the outlines in making a decision. We used the algorithm of the skull-photo superimposition in which the *line connecting the middle of the external acoustic meatuses* served toalignment and scaling images in horizontally direction, the *nasion* and *gnation* landmarks served to scaling images in vertically direction and *top of nasal spine* served as an orientation point for the determination of a deflection angle. In total we estimated 16 landmarks and 14 outlines.

We estimated the significance information of landmarks and their influence on the results, when we received the results of skull-photo superimposition (positive and negative). Thus, we found a group of landmarks that often influence on making the decision on the result of superimposition.

The results of our research confirmed the assumptions about the great identification importance of the central facial landmarks, when using exterior landmarks for the scaling of images.

Creating a ground-truth craniofacial superimposition database

A. Valsecchi[1], O. Ibáñez[2], F. Cavalli[3], B.R. Campomanes-Alvarez[1], C.Campomanes-Alvarez[2], M. I. Huete.[4]

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2Department of Computer Science and Artificial Intelligence, University of Granada, Spain.
[3]*Research Unit of Paleoradiology and Allied Scieces, LTS-SCIT, Azienda Ospedaliera Univeristaria, Trieste. Italy.*
[4]*Physical Anthropology Laboratory, University of Granada, Spain.*

Craniofacial superimposition strongly relies on the achieved skull-face overlay to asses the skull and face relationship. Unfortunately, there is no single objective and reliable method in the literature to determine whether the achieved superimposition is correct or not. This is because two different "objects" (a skull and a face) are overlayed, which introduces an inherent uncertainty.

In this study, we propose a method to create ground-truth or "perfect" craniofacial superimpositions. The first step is to acquire frontal and lateral photographs together with CBCT scans. From the CBCT, a 3D facial and a 3D skull model are created using an automatic approach. Then, homologous points in both the 3D face model and the photograph are marked. The first set of points is automatically projected on the second, leading to a perfect match. Finally, the coordinate transformation corresponding to the match is applied to the skull model, resulting in a perfect skull-face overlay.

Using this methodology, we have created a dataset of ground truth superimpositions, which allows to measure and compare the performance of manual and automatic skull-face overlay methods. With such dataset, a new horizon is opened for the development of new automatic methods whose performance could be now objectively measured and compared against previous and future proposals. Additionally, this new dataset could be really useful for studying the discriminative power of the different criteria for assessing the skull-face relationship.

Modeling the skull-face overlay uncertainty using soft computing and computer vision

B.R. Campomanes-Alvarez[1], O. Ibáñez[2], S. Damas[1], O. Cordón[2]

[1]European Centre of Soft Computing, Mieres, Spain
[2]Department of Computer Science and Artificial Intelligence, University of Granada, Spain.

Craniofacial superimposition involves the process of overlaying a skull with a number of *ante mortem* images of an individual and the analysis of their morphological correspondence. It can provide evidence to support that some human skeletal remains belong or not to a disappeared person. Within the craniofacial superimposition process, the skull-face overlay stage focuses on achieving the best possible overlay of the skull and a single *ante mortem* image of the suspect. This represents the most tedious and time-consuming task and since it is still applied following a trial-and-error approach without a systematic way. The skull-face overlay is influenced by inherent uncertainty mainly because two objects of different nature (a face and a skull) have to be matched. Computer vision and soft computing arise as powerful tools to handle that uncertainty and to automate the skull-face overlay, reducing the time taken by the expert and obtaining an unbiased overlay result. In this work, we present the automatic technical procedure we have developed using these computational methods. We have defined two sources of uncertainty: *landmark location uncertainty* and *landmark matching uncertainty*. In the former case, we propose the use of imprecise landmarks and model them using fuzzy sets. In the latter case, we consider different soft tissue depth studies modeling the mean distance, the subsequent standard deviations, and the orientation by using fuzzy sets again. Hence, our approach overcomes the use of depth markers as it directly incorporates the handling of the corresponding landmark spatial relationships within the procedure. Nineteen skull-face overlay instances corresponding to nine cases have been tested. Our automatic method can be considered as a tool to aid forensic anthropologists to develop the skull-face overlay, automating and avoiding subjectivity.

Skull-photo superimposition: Criteria for overlaying and assessing exclusions

P. T. Jayaprakash
University Sains of Malaysia

Criteria prescribed for skull-photo superimposition serve two purposes; overlaying skull and face images and for assessing the match i.e. inclusions. Landmark based methods for overlaying the skull- and face-images either relate the landmarks in the face and skull considering tissue thicknesses or connect these landmarks using lines or polygons. Criteria for inclusions earlier suggested rely on the relationship of landmarks in the skull- and face-images or on the conformity of the morphology of the organs on the skull- and face-images. Relationship of landmarks or morphological conformity of organs between the skull- and face-images do not appear to be sufficient for suggesting individual identification in view of the findings that many individuals share similar ratio in the placement of facial organs. Reliance on such criteria that are common is likely to lead to more failures to exclude. In as much as exclusions are more challenging than inclusions during superimposition, there is a need for identifying criteria that would increase the efficiency while excluding identification. The criteria for overlaying the skull- and face-images proposed here are based on anatomically homologous structures in a skull and face such as Whitnall's tubercle and exocanthus or auditory meatus and tragus instead of the cranial landmarks that may not be anatomically traceable to corresponding facial landmarks. The criteria proposed for assessing the match include correlations in the asymmetries in the skull and face images that are observed while visually analyzing the silhouette outlines along the superimposing images seen in mix mode or while examining the profile flow of internal organs such as the nasal ridge and the bridge of the nose seen in wipe mode images.

Craniofacial superimposition evaluation with a shape matching algorithm: a study.

L. Lusnig, F. Cavalli
Research Unit of Paleoradiology and Allied Sciences, LTS - SCIT, Azienda Ospedaliera Universitaria, Trieste, Italy.

Although the craniofacial superimposition technique has been developed over a century, to date there is no standard operator-independent methodology to probabilistically determine the matching between the face and the facial skeleton.

The principle of craniofacial recognition is currently based on the assessment by forensic anthropologist on the matching between the cranial standard landmarks and the corresponding facial landmarks, taking into account also the possible correspondence of the osseous profiles with the facial ones.

This paper proposes an automatic and almost completely operator-independent algorithm to determinate the correct cranio-facial matching through the comparison of the different shapes present in the skull under study with the analogous forms contained in the faces applicants to identification.

The algorithm we have developed consists of three steps:

1) Application of a genetic algorithm to obtain a cranio - facial alignment;
2) Determination of the shapes of interest on the 3D image of the skull and on 2D images of the face through edge detection algorithms with the identification of the relative functions (skull shape function, i-th face function);
3) Study of the similarity between the pairs of functions and determination of optimal craniofacial matching.

It's required, as barely operator-dependent step, the choice of 3 or 4 readily identifiable landmarks, depending from the orientation of the photo, as input to the genetic algorithm. The following points are automatically detected by our algorithm, making it robust to human error and minimally dependent on the experience of the operator. Additionally the ability to determine a univocal function to associate with facial image of the subject allows to compare simultaneously and automatically a skull with several subjects' photos to determine the most probable for identification.

The application of the algorithm to different forms (eye sockets, cheekbones, etc.) will allow to use several indicators of similarity for a more reliable matching.

Dental Information in cranio-facial superimposition: the MEPROCS experience and an overview of cases from Victoria, Australia.

R. Hardiman, J. Clement
Melbourne Dental School, University of Melbourne, Parkville, Victoria, Australia.

Teeth and the occlusal pattern can be a unique identifying feature of an individual. The anterior teeth of an individual are the only hard tissue features which protrude from the skull through the external covering of the body and are therefore often visible in some photographs of a particular living individual. In cases where craniofacial superimposition is required for identification, the presence of anterior teeth in the skull and their visibility in an ante-mortem photo can be a useful, very reliable feature as they provide a scale for any images produced for comparison with an unknown skull.

Recent Australian cases using teeth in craniofacial superimposition will be presented to provide examples of different scenarios in which the importance of the dentition is illustrated. These scenarios include whole craniofacial superimposition as well as superimposition of pre-mortem dental impression models and orthopantograms.

The first MEPROCS study contained several cases where an individual's visible dental features were an important consideration in making a decision about a match (either positive, or in deciding to exclude an individual). These will be discussed in terms of the quality of the material and the methods used.

The importance of inspecting the teeth and if required reconstructing the dentition of a skull before attempting craniofacial superimposition will be discussed in the context of the first MEPROCS study.

The use of craniofacial superimposition for Disaster Victim Identification

C. Wilkinson, A. Tilottson
CAHID, University of Dundee

This paper describes a craniofacial superimposition accuracy study carried out using the University of Tennessee William Bass Skeletal Collection.Twenty skulls and two methods of superimposition (manual and computerised) were utilised along with a database of ante-mortem photographs created to represent a MPUB database

These results found that the profile and three-quarter views were the most valuable for craniofacial superimposition. However, the poor identification rate achieved usimg images in frontal view suggests that the MPUB Interpol database would not be optimal for disaster victim identification, and passport images do not provide enough distinguishing facial detail.

2D & 3D Superimposition used in facial comparison of Female-to-Male Transsexuals

S. Mackenzie, C. Wilkinson
CAHID, University of Dundee

In instances when no other comparative image other than a 2 dimensional facial image is available, a 2D to 3D analysis using a combination of morphological analysis and photogrammetry as it is facilitated by 3D superimposition is possible. 2D pre-transition photographs and 3D post-transition facial models of 25 female-to-male transsexual subjects were examined for soft tissue changes following treatment with exogenous testosterone. 3D facial models were created using the FastScan Scorpion infra red surface laser scanner; superimposition was performed in FreeForm Modeling and Photoshop. The challenges specific to a comparative facial analysis reliant on using 2D photographs in the superimposition method are discussed, as are the findings from the assessment of pre and post-testostrone facial images in this unique, discrete, living population.

Contribution of the golden ratio and craniometric indices to craniofacial superimposition – Study in a Brazilian sample

P. Almeida Prado[1], L. Brito[2], Mario Fernandes[3], Margarida Szabo[3], Michel corsato[3], Rogério Oliveira[3]

[1]Federal University of Bahia
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The proportions of the face and the human body are analyzed from ancient times and forensic sciences use these analyses to develop more efficient techniques in human identification. Therefore, the study of the golden ratio and craniometric indices are highly applicable on craniofacial superimposition techniques. This work verified the incidence of the golden ratio from craniometric measures in a sample of sixty skulls (n=60) were obtained from the Forensic Institute of Bahia - Brazil. The measurements were performed directly on the skull, we selected 14 craniometric measurements and from them 03 geometric shapes, 06 horizontal relations, 04 vertical relations and 06 facial index were calculated. Descriptive analysis, contingence tables and an alpha of 0,05 were used to determine significance. The golden ratio (1.618) was not achieved in this sample, however it was possible to establish specific facial indices and coefficients for the evaluated measures, showing regional anthropometric parameters based on the proportions studied. The proportion of head height in relation to face height (V-GN/N-GN) equal to 1.69 was the variable that is closer to the golden value (1.618). Regarding craniometric indexes, the relationship between the height and nose half the height of the face (SN-N = N-NG / 2) gave the value 0.92, which is the most evident parameter. In summary, this study try to establish skulls proportions on the face, contributing to the improvement of additional techniques such as facial superimposition and facial reconstruction in future studies. In addition, this study shows that we should be cautious of differences and develop new methodologies using craniometric indices with regional standards.

Eye fissure dimensions prediction by means of eye-pit dimensions measurement.

A. Rasskazova, E. Veselovkaya
Institute of Ethnology and Anthropology of the Russian Academy of Sciences

The Laboratory of Anthropological Reconstruction of Russia works for many years on improvement of individual facial reconstruction method based on subjacent cranial structures analysis. The craniofacial correspondence program was created, being an algorithm of transition from cranium dimensions and characteristics determined to corresponding facial dimensions and characteristics. A system of equations of regression has been produced to calculate such characteristics as ear height and physiognomic facial height, nose and mouth width.

This report suggests equations of regression for eye fissure height and width calculation on the basis of eye-pit dimensions.The research was based on analysis of photographs of students from 18 up to 26 years old, including 35 men and 40 women.Osseous eye orbit contours were first marked out on faces by palpation. Photographs were taken with respect to standard anthropologic requirements (distance to lens was more than 1,8 meters; scale bar was placed due to face level). The photographs were processed (faces were measured) by a special graphics program.

The eye fissure length was measured from endocanthion to ectocanthion (including lachrymal tubercle); eye fissure height was measured in a place of maximum altitude and also eye orbit width and height was measured according to contour drawn.

An intercomparison of special aspects of the upper eyelid fold and upper orbit edge was made. The analysis of eye shape form and it's correlation to orbit configuration was also developed. The results showed a high correlation between mentioned data. The specific features of eye area asymmetry were analyzed.

Whitnall's tubercle – exocanthion relationship based on craniofacial superimposition images.

H. Hadi, Paul Jayaprakash
University Sains of Malaysia

Detailed craniofacial superimposition techniques have been explained by previous researchers. While overlaying the skull- and face-images, structures in the orbit such as Whitnall's tubercle have been suggested for aligning the exocathus in the face-image. The relationship of the Whitnall's tubercle to the exocanthus has been detailed by authors either through cadaveric dissection or based on MRI on living subjects. However, no research has yet explored the Whitnall's tubercle – exocanthus from a 2-Dimension (2D) craniofacial superimposition perspective based on identifications achieved during one-to-one skull to face photograph superimposition in real life cases that have been investigated. In this research, known one-to-one frontal view superimposition of 20 females and 20 males from forensic cases were selected for analysis. A video mixer was utilised for mixing and wiping the skull and photographic images for superimposition. The wipe mode images included the relationship between Whitnall's tubercle and exocanthus. All images were examined in 'life size'. Distance between the Whitnall's tubercle and the exocanthus was computed and analysed. Distance between the left and right Whitnall's tubercle and the nasion was also selected for analysis. Results indicate that the distance between the exocanthus and the Whitnall's tubercle remains similar between the right and left side of the face supporting the use of Whitnall's tubercle – exocathus relationship during craniofacial superimposition.

Application of the new methods in Craniofacial Superimposition

M. García Corro, U. Pigolkin, A. Mosoyan
Department of Forensic Medicine I.M. Sechenov First, Moscow State Medical University.

This report focuses on the importance of skulls radiographic images study in craniofacial identification, abilities of determining age by features of the sella turcica, frontal and sphenoid sinuses.

97 computer-aided tomography scanning images were selected for the analysis sinuses in lateral projection of persons injured in road accidents.

- The age range was from 4 to 87 years.
- For construction and calculation of the angles and perimeter Adobe Photoshop CS5 extended has been used.

Top of dorsum sellae is O. The point of crossing anteroposterior and posteroanterior diameter of sella turcica(centre of sella turcica- A)
The point of crossing (B) of planum Sphenoidale with a line running through prominent backward item of dorsum sellae and point of transition dorsum sellae to clivus (angle OAB is formed).

Results with respect to age ranges can be concluded as following: (AB)
From 4 to 16 years old: AB is located on the line continuation of posteroanterior diameter within the deviation up to 10 degree.

- From 17 to 35 years old: AB deviates from posteroanterior diameter within 20 to 35 degrees range with the increasing tendency respectively.
- From 35 to 55 years old: AB varies from 35 to 15 degrees.
- From 55 to 65 years old: AB varies from 15-10 degrees.
- From 65 to 81 years old: AB strives for line continuation of posteroanterior diameter.
  (The ratio of the perimeter of the frontal sinus to sphenoid sinus)
- From 4 to 15 year old is 0.3
- From 15-27 years old is 0.5-0.6
- From 28 to 40 years old is 0.7-0.9
- From 40 to 60 years old is 0.8-1
- For 60 and older varies from 1 to 0.4.

The individual features of sella turcica, frontal and sphenoid sinuses are points for identification, which can be used in craniofacial superimposition to establish the biological age.

Tuesday 01 July 2014/ 08:30-09:30: Key note

Dr. C.N. Stephan

HuCS-ID Lab, School of Biomedical Sciences. The University of Queensland (AUSTRALIA)

Carl Stephan holds, 4 yrs experience in an ASCLD-LAB accredited forensic anthropology laboratory (DoD JPAC-CIL, USA) and has 4 yrs lecturing experience at two Go8 Australian Universities in anatomy (The University of Queensland and The University of Adelaide). He was a Forensic Anthropology Analyst for the Mass Graves Team in Iraq (2005), and recently co-chaired the USA SWGANTH Committee on Statistical Methods (2012). He is a member of the Editorial Board for The Journal of Forensic Sciences *and in 2013 recieved the Ellis R. Kerley Award for research excellence in human skeletal identification (radiographic comparison).*

Dr Stephan has published 40 peer-reviewed research papers to include manuscripts in: The Journal of Forensic Sciences, Forensic Science International, The American Journal of Physical Anthropology, Plastic and Reconstructive Surgery, Minerva Medicolegale, The Journal of Forensic Odonto-Stomatology, Anthropological Review, Science and Justice, The International Journal of Osteoarchaeology and Medical Hypotheses. He routinely serves as an invited guest reviewer to 10 journals in the field.

Compiling a Science of Craniofacial Superimposition

To compile a science of craniofacial superimposition, it is crucial that correct and legitimate methods be formalized. This is uncontroversial. However, more common current methods are largely formulated from practitioner's preferences, not data, and so they are unsuited to method standardization. This is not a new elephant in the craniofacial identification laboratory; instead, it has seen little basic research conducted in the discipline over the last 80 years and most attention devoted to practitioner opinion on craniofacial superimposition's utility. Using cases and data this presentation elucidates the problem by examining the validity (and disastrous consequences) of the commonly proclaimed value of superimposition as an exclusion tool, and the lack of consensus over basic principles such as distortion co-variation with skull-camera distance. The substantial challenge that skull-face comparison presents (when the teeth are not visible in smiling poses or absent from the skull), is further elucidated by parallels drawn to the superimposition of clavicles with antemortem chest radiographs, where the latter images provide documentation of exact bony positions. The final call is for more comprehensive and thorough awareness of what the methods entail, less publication bias, more effort in basic research of skull-face relationships, more attention to performance statistics, and more robust and rigorous examinations of methods prior to standardization attempts.

Identification of KGB victims (1944–1947) mass grave site in Vilnius, Lithuania

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In 1994-2003, remains of 724 individuals executed in KGB internal prison were exhumed. The case was considered to be of state importance for historical justice and reconciliation. Archival data contained sufficient ante-mortem evidence for identification. After routine forensic examination, post-mortem database was created, and comparison of those databases served as a basis for working hypothesis (people executed at one night could be inhumed in one pit). As next step, video skull-photo superimpositions were performed. To make our conclusions sounder, we have made our goal that maximal number of individuals from one pit / one execution had to be identified. Already identified individuals served as clues for further identification process. Till now, 60 individuals were successfully identified, and work is still continuing. Independent DNA testing proved credibility of this hypothesis. Cases of successful and problems faced will be discussed. Summing up, craniofacial videosuperimposition proved to be still reliable, fast and inexpensive alternative for person's identification, especially when all available contextual data are taken into account.

Anthropology and genetics go together. Practical case: identification of human remains in a group burial.

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This report contains a description of practical case of identification in a group burial. We consider this case as interesting because complex approach, including both genetics and anthropology, was used.

Circumstances of the case: 4 males in age 18-20 have missed inMoscowregion 10 years ago. In2013 ina stank near the village a car with human bones was found.

The car was lifted from the stank inaccurately and all skeletons were mixed, some bones were lost. That caused a problem, identification became difficult. During second examination of the stank bottom more than 300 bones have been found.

We've used forensic anthropology to minimize the number of objects for genetic tests. As a result, we had 4 skeletons, 50-60 bones each. Sorting of bones complicated by the fact that all deceased had the same sex, similar age and height.

During preliminary identification positive superimposition results were obtained. In order to confirm the preliminary results, DNA tests were conducted. 31 samples of bone tissue were collected. The identity of human remains, presumed to be from missing males, was confirmed. DNA profiles of parents were used as a material for comparison.

However, some mistakes in sorting of bones have occurred. Method of the left-right symmetry determination has confirmed its reliability. Results of craniofacial identification also have been confirmed. Though, some leg and arm bones were sorted incorrectly. Absence of several cervical vertebrae made impossible correct identity determination for two skulls.

The result of this case is a clear confirmation of complex approach necessity.

The craniofacial superimposition in art: the case of the church of St. Catherine of Pasian di Prato (Udine)

F. Cavalli

Research Unit of Paleoradiology and Allied Sciences – Sanitary Technology Laboratory – SCIT

The church of St. Catherine in Pasian di Prato (Udine) is a small sacred building built in the IX - X century and enlarged in the mid-fourteenth century. During its refurbishment an important cycle of frescoes representing scenes from the life of St. Catherine was carried out, dating around 1355. The last scene contains also the portraits of the commissioners of the paintings. The setting of the scene is very accurate and commissioners are realistically portrayed, according to the conventions of that time. The subject placed at the right of the observer is depicted as a well-proportioned man dressed in full armor, while the individual at the left, that shows very fluent hairs and beard, is wearing a simple crimson dress.

During the recent restoration of the church, under the floor adjacent the painting and relevant to the refurbishment, a burial of two male subjects was discovered. Given that this was the only burial existing in the church, and on the basis of anthropological results it was hypothesized that the remains belonged to customers of the frescoes.

A craniofacial superimposition between the only well-preserved skull and the facial image of the bearded man was attempted. A computer-assisted CFS was carried out comparing a 3D MSCT model of the skull with the paint. Facial landmarks were positioned on the paint and the 3D skull object was scaled and rotated searching landmarks and shape correspondence by a 2D - 3D graphical editor (Photoshop©).

Despite the presence of the beard that not allowed the evaluation of the shape of the chin, a good match between craniometric and cephalometric landmarks and a good congruence between bone and facial profiles were observed. This result allowed us to accept the hypothesis of identity between the buried man and the subject depicted in the fresco.

When you're smilin': the role of different expressions in modifying facial 3d morphology

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The introduction of modern 3D acquisition devices has strongly improved the chances of analysis facial morphology, since it allows the operators to perform more reliable metrical and statistical measurements. In addition, the 3D models can be superimposed and the distance between the two scans be estimated by mathematical models. This presentation aims at exposing an application of this potential to the assessment of modifications of facial morphology according to different expressions.

The experimental project was performed on 10 male adults, aged between 32 and 39 years, without facial deformities, relevant pathologies or signs of previous surgery. The face from each individual underwent to four acquisitions by stereophotogrammetry (VECTRA-3D®: Canfield Scientific, Inc., Fairfield, NJ): in each scan the subjects have different facial expression (neutral, sad, happy, surprised). The 3D model focused on the facial oval area included between the trichion, the lower edge of the mandible and the line between gonion and tragion. On each 3D facial model, 9 landmarks (right and left endocanthion, exocanthion, cheilion: on the midline, selion, pronasale, subnasale) were identified using VAM® software; the neutral acquisition was then superimposed with the other ones of the same individual representing specific expressions. The superimposition was performed in order to reach the least distance between the corresponding landmarks. In all the cases, the RMS value (Root Mean Square) between the two models was calculated; in addition the maximum and minimum difference was evaluated.

Results show appreciable differences in RMS values between various facial expressions: in addition, the chromatic assessment of facial superimposition was able to highlight areas where the modifications were more relevant in different conditions. This pilot study has therefore provided an example of the streong impact that 3D acquisition systems may have on the anatomical analysis of facial characteristics.

Three-dimensional analysis on face shape variation and aging-induced changes in Japanese population

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National Research Institute of lice Science, Japan

In order to obtain the data for forensic facial comparison cases, variation and aging-induced changes of facial shape were examined. Three-dimensional (3D) facial shapes were taken from 876 Japanese males using a range finder (Fiore, NEC, Japan). Homologous models consist of 10,741 anatomically corresponding points were created for these faces with 33 landmarks defined. A principal component analysis (PCA) was made on the positional coordinates of whole points in the homologous models to reveal predominant shape variation. Twelve principle components (PCs) of which proportion of variance over 1% were found and cumulative proportion of them reached to 78.1%. The first PC (PC1) and PC2 explained well about the variation in the facial width and the facial depth, respectively. The PCA was also applied to facial parts (nose and lip) segmented from the homologous face models, and the variations were also shown clearly at both the parts. We created additional homologous face models for 147 individuals whose facial shapes had also been taken around 10 years ago. Positional shift of corresponding points between present and previous faces were analyzed in each individual and aging-related shape changes, such as deepening of sulcus nosolabialis and sulcus buccomentalis, drooping of the lower part of the nose were quantitatively visualized. These aging parameters enabled us to age a given homologous model virtually at any age. The result obtained in this study would be useful not only for performing facial comparison but also for cranio-facial superimposition with considering aging effect in face. Besides these 3D aging analysis, aging studies on textual 2D face images using the PCA and the Wavelet transformation will also be presented.

Typology of faces as a source of data for the craniofacial identification.

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Research in this field can be helpful, as it adds a opportunities to substantiate the results of craniofacial identification.

Rare signs are the most important for identification, however for reliable identification it is best of all to use not separate rare signs, but their combinations.

The aim of this work was to reveal a set of attributes considered rare variants and pick up certain rare combination and the corresponding types of faces and sculls. This path can be a justification for the statistical evaluation of craniofacial identification.

To achieve this goal we have analyzed the data of anthropological studies conducted in Belarus. Given the initial results, we carried out independent research. Some results are based on statistical data compiled on one million observations.

According to the results of the analysis of values of the separate sizes were calculated, and also combinations of signs with various frequency of occurrence are allocated.

The greatest attention was paid to release sets of rare signs and types of faces/sculls corresponding to them. Then comparison received for types of persons and skulls, therefore the general tendencies were revealed.

This study is part of a larger work on the development of algorithms for habitoscopy and craniofacial identification. The results obtained can be used in the preliminary selection of objects for comparison and as a complement to photo superposition method to confirm the results of craniofacial identification.

An Application of an Automatic Skull Fragment Reconstruction Method to obtain 3D Skull Models for Craniofacial Superimposition

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Craniofacial Superimposition is a forensic identification process that involves the superimposition of the skull and a set of *ante mortem* images of the individual. In order to properly apply the technique, the use of a normal (not damaged) skull or a skull model is required. However, skeletal remains are often damaged or fragmented, especially in some scenarios such as accidents, natural disasters, or mass graves. In these cases, a previous skull reassembly step is necessary to obtain an appropriate skull model. This step is a really challenging and time consuming part of the process and it is usually accomplished manually by a forensic anthropologist, gluing the fragments together and preparing the skull.

The objective of this contribution is to validate an automatic skull reassembly method by applying it to a real case scenario using a fragmented skull from the Physical Anthropology Lab at the University of Granada. This method allows us to automatically obtain a reconstructed 3D skull model, which can be then considered as an input to any computer-aided Craniofacial Superimposition technique.

The considered automatic method is guided by a template, which consists of a representative complete skull model with similar characteristics (age, sex, ethnic group, etc.) to the fragmented one, reducing the anthropologist work to determining the approximate biological identity of the remains. The reassembly procedure consists on a feature detection step which extracts distinctive geometric information of the fragments. Then, those features are matched between points in the fragments and the template, determining the correct transformation that has to be applied to each fragment in order to fit the template.

Fuzzy Spatial Reasoning applied to Craniofacial Superimposition

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Within the craniofacial superimposition process, the skull-face overlay stage focuses on achieving the best possible overlay of the skull and a single *ante mortem* image of the suspect. In previous work, we presented an automatic method to aid forensic anthropologists to perform the skull-face overlay, automating and avoiding subjectivity of the most tedious task within craniofacial superimposition. Next stage, decision making, consists in evaluating the skull-face correspondence through the resulting skull-face overlay. For this task the anthropologist analyzes the degree of matching of a set of criteria such as the soft tissue thickness at some landmarks, the consistency of the bony and facial outlines, and the anatomical skull and face consistency trough the assessment of some positional relationship.

Our final goal is to design and implement a decision making algorithm that supports expert decisions with objective and automate measurements. While in the case of soft tissue thickness the problem is related with distance measurement, the latter two set of criteria are much more difficult to be analyzed by a computer. It requires to mimic the expert knowledge of the morphological correspondence as prepositions of place (along, above, etc.) and similarity of different but analogous anatomical structures (face and skull). This correspondence of face and skull structures is never precise due to the present of soft tissue. Thus, in this work, we face that challenge problem by proposing the use of fuzzy spatial reasoning to evaluate the spatial morphological correspondence between a superimposed skull and a face in a photograph. We validate our approach in some cases comparing the results given by the algorithm with those assigned by an expert in the field.

Utility of the facial 3D scanner and 3D-max software; applied for the reliability of the superimposition of images in nn and faces facial skulls in the criminalistics research

D. J. Humpire Molina
Public Ministry of Peru

This research serves as a utility to identify through the superimposition of images in people who were recorded by security cameras in assaults on financial agencies, kidnappings, riots and other skirmishes that allow the use of the 3D scanner and 3D Max software applied in a skull or alleged person involved in a criminal event. The program located cephalus-metric skull-metric, flat points and measured the distances of each facial anatomical point existing on the skull and facial faces for your comparison, approval with the aim of identifying scientifically through the study of facial morphology. The purpose of this research is to show the results obtained in Peru based on the superimposition of images with the use of the three-dimensional scanner FASTSCAN Scorpion, mark POLHEMUS, with a sample of study of 384 persons of both sexes the same which were scanned and subsequently performed the procedure with her photographs from different angles RENIEC tab; finding a 3% to 2% margin of error for considering the year of the photographs overlap with software 3d Studio Max. Arriving to obtain positive identification, still the same less expensive than DNA and steeper in the human identification

Automated Facial Recognition of Craniofacial Reconstruction Models

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CAHID, University of Dundee

This research aimed to address the problem of identifying skulls in a mass fatality incident (MFI) where dental / DNA matching is impossible. The objective was to adapt or produce a facial recognition system which would 'recognise' a forensic craniofacial reconstruction (CFR) and 'match' it to a passport-style photograph, on the assumption that such images may be contained in a missing persons' database (e.g. Interpol MPUB). This study utilised adult male CT data and accompanying facial photographs from the University of Tennessee.

Existing commercial facial recognition systems were tested before an ad hoc system was produced. The system was tested using facial photographs; accurate 3D models of faces (CT and laser scans); 5 CFRs of known targets; then 5 CFRs of unknown targets.

Results indicate that it is possible to narrow the field of inquiry by automatically ranking a database of frontal facial photographs in order of similarity in shape to a CFR model; then carrying out subsequent craniofacial superimposition on the top 20% of the database to further narrow the search.

(Part of the FastID project, in collaboration with Interpol, Fraunhofer Institute, Plassdata, BKA)

Face off – In vivo facial soft tissue depth for German adults

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Forensic facial reconstruction may be the final option available to draw the public attention in cases where the identity of an individual cannot be established by standard identification methods. Two fundamental components of all forensic facial reconstruction techniques are cranial morphology and population-specific soft tissue depths databases.

The material for this pilot study consisted of 72 (36 male, 36 female) anonymised multi-slice CT scans of individuals drawn from a German population. Individuals between the ages of 18 and 82 years were analysed. Their statures varied between 1.55 m and 1.92 m; their weights ranged between 50 kg and 120 kg. The BMI fluctuated between 17.9 kg/m^2 and 40.5 kg/m^2. Patients with severe trauma or pathologies that may compromise facial soft tissue depth were excluded from the study as were patients known to have been treated with specific medication (e.g. cortisone).

In Amira, the surfaces of the face and of the skull were semi-manually segmented using thresholds and surface extraction algorithms. The parameters were adjusted to permit semi-transparent visualisation and examination of both structures simultaneously. Facial soft tissue depth was measured at 10 midline and 28 bilateral anatomical landmarks.

The analysis of facial soft tissue thickness *versus* BMI, sex and age, for each landmark separately, indicated that, at a number of the landmarks, facial soft tissue depth is influenced by the three traits. It increased with increasing BMI, but the facial soft tissue thickness variations with age and sex were insignificant. The differences between males and females were statistically significant ($p < 0.05$) for almost all anatomical landmarks with the exception of a few in the region of the nasal root and orbitals. The differences between the results from this sample and those obtained from comparable population-specific databases contradicted the hypothesis that population-specificity significantly influences facial soft tissue thickness.

Craniofacial Superimposition case studies at the Legal Medicine School of Madrid

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The Legal Medicine School of Madrid started to work on cases in which it was necessary to apply the technique of Craniofacial Superimposition from the mid- 80s. This technique was used when it was not possible to identify the individual by other methods in order to give a response to the Administration of Justice. At that time the Legal Medicine School received all cases where the opinion of an expert in forensic anthropology was needed as it was the only institution in Spain that provided Laboratory in Forensic Anthropology. From 1986 to 2000 more than 30 cases were studied using the Craniofacial Superimposition technique and a compatible identification was achieved in 50 % of the cases. In some other cases exclusions were established and the rest undetermined conclusions were performed because the available material was not enough or it was not in appropriate conditions. In all the cases was applied video superimposition technique using a video camera and the VIDAS image analyzer software. This method allows overlaying a video image live skull with a delineated photograph image. Currently, coinciding with the participation of the Legal Medicine School at Meprocs Project, a collaboration with the Forensic Anatomic Institute has been established to apply the protocol created by the Project in case studies entering the Laboratory, there are two at this point. The methodology used in these later cases is based on 3D technology, the skull is 3D scanned using the 3D laser scan PICZA, the different orientations are merged using Pixform software and the treatment of the images is performed with Geomagic software. The overlay is done with the program Photoshop CS6 and finally one of the 7 categories defined in the protocol is assigned to the overlap obtained.

Craniofacial superimposition in the identification of Adam Muchtin – a priest on his way to beatification

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The paper presents a case where forensic specialists have been requested to analyze and identify the remains of a priest named Adam Muchtin, died in 1994, whose life and virtues have deeply indebted the community where he lived and served as a priest. The identification was requested since the community wanted to move the remains of the priest into a separate crypt in the church he built, but this were commingled with the skeletal remains of his immediate family. Namely, between 1994 and 2013, the remains of Adam Muchtin, his mother, father and sister have been relocated causing fragmentation and commingling of the human remains. This made the identification of the priest impossible without a targeted anthropological analysis.

Anthropological analysis, carried with the help of the medical documentation and photo-documentation of Adam Muchtin, as well as oral testimonies of people who knew him, helped in the identification of part of the priests' remains.

Only two complete skulls (one male and one female) have been retrieved from the remains. To obtain a more relevant identification diagnosis a craniofacial superimposition (CFS) was attempted. A computer-assisted CFS was carried out comparing a 3D laser-scanner model of the skull with Adam Muchtin's old and recent photos. Facial landmarks were positioned on the photos and the 3D skull object was scaled and rotated searching landmarks and shape correspondence by a 2D - 3D graphical editor (Photoshop©). At the end a positive identification was made.

Craniofacial superimposition: four case studies from South Africa

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Craniofacial superimposition (CS) is frequently used in South Africa as an aid to identification as many people do not have dental records and it is sometimes difficult to find DNA for comparative purposes. Here we report on four different cases where this technique was used, each demonstrating different scenarios where CS may be useful. The first case from Dundee, Natal, demonstrates a single superimposition to help confirm identity. The individual in question was an orphan, and no comparative DNA samples were available. The second case involved identification of two people killed in a hijacking incident, and here CS was used to support identification that was already partly confirmed by the presence of identity documents. The third case involved a serial killer from Swaziland (35 counts), where there were many skulls and photos of victims, and an attempt was made to match some of the skulls with specific people. The fourth case is a historic case of decapitation, where an 1895 black-and-white photograph of the decapitated head was used in an attempt to find the actual skull. Here the photograph and 10 skulls were superimposed, with one of them identified as a possible match. CS is a very valuable technique, which will continue to play a role in the South African forensic setting.

Ethical and Legal issues in CranioFacial Superimposition

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With an ever increasing population, identification of an individual is one of the greatest challenges we face today. This situation is further perplexed by the wide diversity of races and cultures that coexist. To maintain law & order identification is essential not only for the living but more importantly for the dead especially in un-natural deaths or crime related deaths. The onus of solving this problem lies on the shoulders of scientist community. A step in this direction is development of reliable, accurate and upto date Craniofacial Superimposition technique or improvising upon the existent system.

Superimposition is a comparison between the antemortem photograph of an individual with an unidentified skull, although it may also be a method of facial comparison in the living. Forensic cases have proved that the technique of facial superimposition can be used to assist in the identification of individuals from unknown skulls.

There is a huge lacuna of information and knowledge on the craniofacial superimposition ethics and laws not only among the medical fraternity but general population at large. As ignorance is no excuse, it is duty of anyone & everyone to know the laws which concerns him or her.

Ethically it is essential to obtain consent from the acclaimed family members who claim the deceased person as their family member, in order to establish the identity by superimposition technique. Although, no documented cases are available in India where court has accepted craniofacial superimposition as primary means of Identification, there have been cases where identity establish by craniofacial superimposition has been confirmed by DNA.

So periodical CME programme in medical ethics should be mandatory for all practitioners, in order to familiarize themselves with the regulations and laws that concerned with this useful and reliable technique.

Ethical and Legal Issues in forensic anthropology: from craniofacial superimposition to identification of the living

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In the past years forensic anthropology has considerably increased its fields of professional and research applications. This necessarily requires an up to date and practical discussion of the ethical issues concerning the use both of human remains and of photographic/clinical data, i.e. the main objects of anthropological activity.

The aim of this review is to analyze ethical and legal issues involved in the application of the most common procedures of forensic anthropology; in addition we will focus on the use of images in the forensic practice and the application of craniofacial superimposition, considering the growing common multicentric frameworks which will allow for the extensive application of anthropological techniques in practical forensic identification scenarios**.**

Ethical issues relate to proper consent for the acquisition of documented data from known individuals, protection and proper storage of data and appropriate scientific utilization of the data. We need to consider, in this ethical reflection, all the involved groups: the victims or deceased, their families, all the professionals and finally, the society.

We finally conclude that informed consent represents an essential ethical cornerstone of database construction when individuals are known and if the remains have been claimed. Protocols must be followed to ensure that data are properly acquired, stored, used and shared.

Ethical and legal considerations involved in the study of human skeletal remains for investigative purposes: Craniofacial Superimposition

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The main objective of the technique of craniofacial superimposition is to establish the identity of a victim. The method allows one to identify an individual by comparing an antemortem photo with a skull. Due to continuous technological developments, the technique is gaining importance in the field of Forensic Anthropology. Employment of this method implicates the obtaining and use of human biological material and the information associated with it. This carries important ethical problems for both the individuals under study and the researchers. The studies that are carried out in this field, which are increasingly more common, require the participation of other human beings; it is therefore necessary to obtain the informed consent of individuals whose data will be incorporated into the investigative process. Present legislation gives great importance to the protection of individual privacy, confidentiality, and honor as well as the protection of personal data and images. The protection of patient information should be strictly preserved. The role of the researcher is the key to guaranteeing this protection. The researcher has the ethical and legal obligation to assure the prudent use of data while always respecting people's rights as well as to provide enough information to participants considering the risks, benefits, consequences or problems that could arise during the study. The objective of this study is to carry out a detailed analysis of present legislation and jurisdiction, thus providing a series of guidelines for the use of this kind of information while considering the most relevant subjects from an ethical point of view. Presented here are the results of an extensive review of different elements based on informed consent, data protection, the relationship between the subject and object of study, proportionality, and Ethical Committees from their components to their ethical and legal foundations.

Automatic cephalometric landmarks estimation in Cone Beam CT

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Forensic medicine, craniofacial surgery and orthodontics make wide use of cephalometric analysis in identification, diagnosis and surgical planning. In order to measure linear distances, angular apertures and geometric features of the individual skull bones, an expert usually annotates by hand a set of cephalometric landmarks onto two-dimensional radiographic images or three-dimensional surface renderings of CT or Cone Beam CT volumes. Currently, the development of CBCT scanners has led the 3D cephalometric analysis to become a normal procedure, due to the improvement in the evaluation of three-dimensional morphology of subjects.

Accuracy and repeatability of this manual approach are limited by intra- and inter-subject variability in landmark identification, even if an expert user takes care of the task. In order to improve the manual annotation, we propose a nearly-automatic method that gives the user an estimate of the positions of nine selected landmarks and a confidence region for each point, using as reference an accurate, manually annotated, single-subject CBCT volume. The method is based on intensity-based registration, on segmentation and on surface extraction of the CBCT target volumes.

The confidence regions for each landmark have been preliminary estimated by testing the method on 21 CBCT volumes and by calculating Euclidean three-dimensional distances between the automatically annotated point and a standard manual cephalometric annotation done by an expert user. The obtained results are promising, annotation errors are acceptable for most points and the algorithm has good performances even in the presence of metal artifacts. Method improvements and a strong validation are currently in preparation.

Marking constant points on the faces in different projections. Truth and Lies.

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This work is devoted to determining the reliability of landmarks on their faces, to establish their validity and appropriateness of use in craniofacial identification.
My used images of 8 volunteers in 3 projections and 10 specialists' markup produced 40 landmarks.

The work was done together with experts of laboratory reconstruction appearance on the skull, and they also investigated 8 of our volunteers, and then we compared their data.

To assess the results, we compared the experimental layout and images of people's faces with markings landmarks on the faces themselves.

At the same time, we have identified a number of conditions and restrictions on the use of the images of the points for that depends on the projection.

We have confirmed the assumption that the restriction conditions suitability most points for craniofacial identification. The statistical data on the 8 points showed their complete unsuitability for use in craniofacial identification.

Variations of midfacial soft tissue thickness in subjects aged between 6 and 18 years for the reconstruction of the profile: a study on an Italian sample

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Facial approximation techniques used in forensic anthropology are usually based on databases of soft-tissue thicknesses. Only few studies concern the facial soft tissue thickness in children; however, the assessment of subjects aged under 18 years may provide relevant advantages for facial reconstruction in cases of crania of unidentified subadults. This research aims at adding an Italian database of the midfacial soft tissue thicknesses from a population aged between 6 and 18 years, composed of 230 individuals (divided into 94 males and 136 females). Lateral cephalometric X-rays were photographed and 14 soft tissue measurements on the sagittal plane (supraglabella, glabella, nasion, nasale, subnasale, superior labial sulcus, labrale superius, stomion, labrale inferius, inferior labial sulcus, suprapogonion, pogonion, gnathion, menton) and the nasal depth were taken with Photoshop CS6, according to the metric reference. Mean values, standard deviations and ranges were then calculated and the relationships between soft tissues, age and sex were statistically investigated using t-tests. No points showed significant differences in facial tissue thicknesses between males and females up to 11 years old, while significant differences were observed at some landmarks from the age of 13 (primarily in the mouth region, in detail at the pogonion and gnathion); in addition, significant differences in age were observed dividing the sample into groups of at least four years among males (at the labrale superius) and of at least three years among females (at the glabella, subnasale, labrale inferius, suprapogonion and pogonion), suggesting that the trend of increase of the soft tissue thicknesses was quite different according to sex and slightly quicker in females.

This study provides some insight for the development of a databases of soft tissue thicknesses for Caucasoid children and adolescents.

Constant points and anatomical landmarks in craniofacial identification

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This report aims to tell about study of the classification of constant anatomical points and anatomical landmarks, which are currently conducted by several organizations in Russia. This problem is interesting because in various information sources different classification and naming of the same anatomical and morphological elements can be found. As well misinterpretation of conformity between the landmarks of face and skull can occur. All this affects the accuracy of facial reconstruction and the results of craniofacial identification. Therefore the development of unified classification is very useful.

In this paper we propose a unified system which includes two series of landmarks – for skull and for face. We also offer a description of the exact location of landmarks. System of interconnections between landmarks on the face and on the skull is offered for discussion of scientific community. Several additional points are recommended. The proposed system allows to improve and unify the procedure of cranio-facial identification and reconstruction.

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