



## Physical Anthropology Section – 2009

### H61 Skull/ Photo Superimposition Validation Study

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The goal of this presentation is to demonstrate a unique method of validation using skull models from living subjects.

This presentation will impact the forensic community by illustrating how advances in technology can provide new validation methods from living subjects.

The mission of the Joint POW/MIA Accounting Command Central Identification Laboratory (CIL) in Hawaii is to search for, recover, and identify missing U.S. service personnel from past wars.

Difficulties in identification present themselves when the skeletal remains are of similar biological profiles, commingled, and when mtDNA testing is not possible due to poor preservation of the osseous remains or the lack of comparative family reference samples (buccal swabs or blood drop cards). A quantitative Cranial/Photograph Superimposition technique has been developed at the CIL to support vetted identification methods (anthropological analysis, dental record and historical record comparisons) and as a means of probable exclusion when inconsistencies in congruity can not be explained. The quantitative Cranial/Photograph Superimposition incorporates a line-up of photographs for blind analysis comparison to the crania. Using video-camera overlays, each photo is aligned to the 'best possible fit' by resizing each photo and adjusting/aligning the skull to fit with the subject's facial orientation as depicted in the photo. Alignment criteria scoring is used to rate the congruity of ten features of the superimpositions. Each feature is scored as a +1 (good fit), -1 (lack of alignment), or 0 (for areas not seen in the photograph or if there is trauma to the skeletal remains). This scoring procedure results in a final comparison sum, with a maximum of ten points for each photographic and skull comparison.

As with all new methods, validation is crucial in determining the accuracy and scope of use, and requires a known-error rate of the method or procedure based on known comparatives (crania). This research will demonstrate the use of CAT scan data to generate precise 3-D copies ("models") of skulls of known individuals (living CIL staff members) that are then used in a comparative study of cranial alignment using skulls and photographs as developed at the CIL. Ten current and former CIL employees with like gender and ethnic affiliation were chosen for the known sample group. All subjects were CAT scanned using the lowest slice rate possible in order to optimize the detail of their cranial features. The raw x-y-z data from each CAT scan were converted to a 3-D print file. Three dimensional replicas of the ten skulls were produced, cleaned, infused with a hardening agent, and assigned bar codes (for concealing the skull identities). Scoring sheets with matching bar codes were provided to the test participants for each skull's comparison.

CIL summer interns and new employees were chosen to perform the validation study. All participants were individually taught the CIL's quantitative scoring, blind photo line-up procedure, and were given an opportunity to practice the method on various non-study related material prior to beginning the validation study. The participants aligned, compared, and scored ten photographs with each skull.

Preliminary results indicated that intern examinees at the CIL selected the correct photograph in 40% of cases examined (i.e., found no inconsistencies between the corresponding/actual photograph and skull) and eliminated all other photographs in the blind "line up." The false positive rate in this study was 60%. Additional work by researchers beyond the novice level and with varying experience is necessary before drawing final conclusions on the accuracy or utility of photo superimposition.

#### **Superimposition, 3-D Models, Validation Technique**