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## **Project Narrative**

Solicitation: **Research and Development in Forensic Anthropology and Forensic Odontology**

**2008-NIJ-1793 - SL# 000802**

Project Title : **A Radiographic Database for the Estimation of Biological Parameters  
from Subadult Remains**

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## **Abstract**

Current techniques in forensic anthropology for estimating age at death in fetuses, infants, and children (subadults) are of questionable reliability due to a lack of data from modern cohorts, from non-White cohorts, and of appropriate statistical methods. This proposal will establish a database of digital radiographs and demographic data from modern American subadults. Radiographs obtained from Medical Examiner Offices provide anthropologists with a means of assembling large amounts of data from modern subadults with known age, sex, ancestry, date of birth, and other demographic information. An initial application of radiographic data will be the measurement of long bone lengths for age prediction. Radiographs magnify and distort, but software developed through this proposal will allow the calculation of estimated actual bone lengths, providing comparative data essential for forensic anthropologists working with skeletal remains and for forensic pathologists working with fleshed remains. The software will also aid forensic professionals in predicting age from bone lengths with appropriate prediction intervals based on data collected under the grant. The database, once established, will continue to grow through ongoing contributions from medical examiners around the country. This growth will be facilitated by the increased use of digital radiography. The creation of such a database will not only provide the most reliable sex and age standards with statistically determined age prediction intervals, but will also open up further avenues of research, such as estimating ancestry in subadults. This radiographic database will complement data from adults

compiled in the Forensic Data Bank at the University of Tennessee, Knoxville, established through a grant from the NIJ in 1986 (Ousley and Jantz 1997).

## **Introduction**

According to the National Crime Information Center's Missing Person File, in 2006 there were over 110,000 active missing person records listed. While statistics on missing children by age group (infant, child, juvenile) are not recorded, over 50% of those missing persons were eighteen and under. Also, in the US from 1975 to 1999, in contrast to other Western countries, homicides of individuals 14 years old and under, and infants in particular, rose significantly despite a reduction in adult homicides (Pritchard and Butler 2003). In fact, the estimated homicide rate in 14 year-olds and under from 1995 to 1999, which may well be an underestimate, was higher than for all other age groups combined (Pritchard and Butler 2003).

Given the number of murdered and missing children, and the fact that the known age of the missing individual can help narrow down possible identifications of unknown subadult remains, it is surprising that no well-established standards exist for skeletal age estimation in modern subadults. Frequently, forensic anthropologists estimating age in children rely uncritically on data that may have been collected over 60 years earlier or even from historic archaeology contexts. It has been well documented that American populations, and many others, have shown significantly greater early childhood growth, earlier development and maturation, and larger stature than in previous generations (Heuze and Cardoso 2007; Meadows-Jantz and Jantz 1999; Nadler 1998). As a result, data from subadults born in some cases over 70 years ago are inappropriate for use in estimating age in modern subadults. Additionally, the vast majority

of cited growth standards involved only children of European (White) ancestry. Applying standards from children in one group to other groups with different growth trajectories can produce age estimates that differ by three years or more (Ousley *et al.* 2005). Crowder and Austin (2005) found a difference of two years in epiphyseal union times of the distal tibia and fibula among modern African-, European-, and Mexican-American teenagers. Further, any age estimate range for a subadult involves a reasonable guess that is unreliable because it has little or no empirical basis. An overly wide age range may result in too many possible identifications, making verification more daunting. On the other hand, an age range that is too narrow may exclude the missing child as a possible identification. Thus, appropriate reference data are unavailable for the successful identification of modern subadult remains.

The need for a resource on modern growth may be best illustrated by a recent forensic case that was analyzed in the summer of 2007 at Mercyhurst College. Forensic anthropological consultation was requested by the Erie County, PA, Forensic Pathologist on the incomplete skeletal remains of a partially decomposed infant. Dental development could not be assessed because the maxilla was missing and the mandible was incomplete, with no developed teeth seen in the radiograph. Lacking dental indicators, the standard approach for estimating the age of an infant utilizes long bone lengths. Scheuer and Black (2000), the standard anthropological reference text used in evaluating immature skeletal remains, provides average bone lengths by age, citing Maresh (1970). Although Maresh's work was published in 1970, it was based on data collected in the 1930's. As mentioned, modern children grow at a faster rate, achieve a larger size earlier, and end up as taller adults than in earlier times, a phenomenon known as a secular increase (Meadows Jantz and Jantz 1999). Therefore, any estimated age based on the obsolete data would likely overestimate age because modern infants are larger. Additionally, no

information regarding variability by age is listed in either Maresh (1970) or Scheuer and Black (2000). Therefore, it was impossible to calculate an age prediction range. As is often the case, a range for estimated age at death for a modern infant was merely a reasonable guess. Thus, the forensic anthropologist cannot construct an age estimate or appropriate age range from modern remains due to 1) samples from chronologically inappropriate cohorts, 2) a deficient empirical foundation, and 3) an inadequate statistical foundation. This case study illustrates that the current state of forensic anthropology regarding age estimation in subadults is inadequate. There is not a reliable basis for calculating a point estimate for age, or for an estimate range for modern subadult remains.

Substantial collections of modern subadult skeletons with known demographic information are virtually unknown (Feldesman 1992; Shapiro and Richtsmeier 1997). Most large museums, with frequently researched collections, have not actively collected significant numbers of skeletons in decades. Despite a rise in donated adult bodies to the Anthropological Research Facility at the University of Tennessee, Knoxville, donations by parents of their deceased children are exceedingly rare. In the absence of modern subadult skeletal collections, forensic anthropologists must instead turn to radiographic documentation in an effort to bridge this gap. Radiographs from the living, such as those collected during the classic Fels longitudinal study, begun in 1929, offered tremendous insights into development and maturation in earlier cohorts of subadults (Roche 1992). Other longitudinal research begun by Maresh in the 1940's (Maresh 1970; Maresh and Deming 1939) involved taking radiographs of living children to indirectly measure the long bones. These radiographic studies of the living were largely limited to data from children of European (White) ancestry, focused on only a few skeletal elements, and have diminished due to the rise of concerns with unnecessary radiation exposure. Also, numerous

clinical radiographs of children have been taken in emergency rooms, but traumatic events usually generate only radiographs of specific elements.

Full-body radiographs are not taken in a clinical context, but extensive and often full-body radiographs are routinely collected by medical examiners and coroners during postmortem examination of fetuses, infants, children, and many subadults. These radiographs form the most comprehensive sample of osteological information from modern subadults. Information regarding age, sex, stature, ancestry, birth date, anthropometric data such as stature or crown-heel length, weight, and manner of death are recorded in these cases. In all research involving growth, it is essential to obtain large samples by age, ancestry/ethnicity and sex, and not merely a large sample in total. A radiographic sample derived from a morgue population of subadults is essentially the only modern source that can provide enough linked radiographic and demographic information. Because the process of radiography involves magnification and distortion effects, any study incorporating measurements from radiographs must compensate for those effects. Estimating and compensating for magnification and distortion effects is discussed in the Research Design and Methods section.

### **Purpose, Goals, and Objectives**

The overall objective of this project is to provide up-to-date information for the optimal estimation of biological parameters to aid in identifying the remains of modern fetuses, infants, children, and adolescents.

The primary goal of this project is the creation of a database of digital radiographic images and demographic information from modern American individuals up to age 20. This database will complement the Forensic Data Bank at the University of Tennessee, which has

proven indispensable in numerous forensic applications involving modern adults (Ousley and Jantz 1997). A large collection of radiographs and a linked demographic database will provide numerous research opportunities in discovering and refining methods of estimating the biological profile (age, sex, ancestry/ethnicity) in subadults. This database, like the Forensic Data Bank, will be supplemented by additional cases in the future, continually adding up-to-date information from subadults of various ethnic backgrounds.

The second goal of this proposal utilizes the radiographic data to provide new methods of estimating age in subadults using measurements of radiographs. After enough data have been collected, statistical methods will be incorporated into a free computer program that will aid in the collection of bone measurements from radiographs. The computer program will also use the data collected to provide an age estimate for an individual with appropriate and correct prediction intervals.

### **Review of Relevant Literature**

As mentioned above, Scheuer and Black's (2000) book is the exemplar for juvenile skeletal biology. However, it is clear that Scheuer and Black (2000) was not intended for use by forensic anthropologists, despite its widespread use by them. All age-related information from subadults presented in Scheuer and Black (2000) show the same inadequacies discussed above: a lack of data from modern cohorts and non-White ancestral groups. It seems quite likely that age estimation based on the available standards is neither valid nor reliable.

Estimated age at death in subadults is a composite of morphological changes, size changes, and a progression through developmental stages. The two approaches most commonly



used in the age estimation of subadults are long bone diaphyseal lengths and dental development and eruption. Compared to other developmental processes, dental development is more strongly genetically controlled and therefore more reliable than other methods for estimating age at death (Ubelaker 1978; Lewis and Garn 1960). For this reason, when teeth are available, forensic anthropologists tend to primarily utilize dental development to estimate age in subadults. When dental elements are not available, measurements of the long bones are relied upon for age estimation.

***Dental Development*** One of the most recognized dental charts was developed by Schour and Massler (1941). Their diagram, highlighting patterns of formation and eruption of the deciduous dentition, illustrates 22 stages, each associated with a particular chronological age. However, Schour and Massler's 1941 publication, as well as all reproductions, omit information regarding the original data sources. Their work was apparently adapted from Kronfeld (1935). The data source for early dental development in Kronfeld's 1935 publication consisted of only a small number of terminally ill children, most of whom died before the age of two, and therefore they do not likely represent normally growing children (Hillson 1996). A further revision of the illustration was provided by Ubelaker (1978). Ubelaker's (1978) chart is utilized quite frequently as the standard for anthropological dental age estimation for remains of forensic, biological, or archaeological origin (Hillson 1996). However, according to Ubelaker (1978), the chart is an amalgamation of seventeen different studies ranging in publication dates from the 1940s to the 1970s, and also from American Indians (with unknown ages) and other non-white populations. How these various studies were incorporated into the dental development charts by age is unknown. Additionally, rather than scoring the development of individual teeth, practitioners simply "eyeball" Ubelaker's chart, which generalizes tooth development and eruption, making

an accurate age range calculation impossible. Different ancestral groups show different patterns of dental development and eruption (Tompkins 1995), and working with a chart forces the expert to choose certain tooth eruption patterns over others.

Another frequently referenced study is that of Moorrees *et al.* (1963a, 1963b) in which development stages of individual teeth were evaluated using radiographs collected during the Fels Longitudinal Study, which began measuring and x-raying predominantly middle class children of European (White) ancestry in 1929 (Roche 1992). Although Moorrees *et al.* (1963a, 1963b) provided mean developmental stages and standard deviations for each tooth, and the populations sampled were of known sex and age, their sample originates from nearly eighty years ago, and should not be applied uncritically in a modern forensic setting. There are independent indications that some populations have experienced significant secular changes in dental development in the latter half of the 20<sup>th</sup> century, with modern children reaching dental developmental milestones over a year earlier than children born previously (Heuze and Cardoso 2007; Nadler 1998). Additionally, statistical approaches using the developmental status of teeth or skeletal indicators have rarely been employed (*e.g.* Boldsen *et al.* 2002; Heuze and Cardoso 2007)-, making age predictions once again a reasonable guess. In summary, the data sources of the predominant dental development studies originate from antiquated, heterogeneous, or unknown samples, were applicable only to European (White) groups, and are therefore of questionable reliability in a modern forensic setting.

***Long Bone Lengths*** Principle studies regarding age estimation using long bone diaphyseal lengths include Ghantus (1951), Anderson *et al.* (1964), Trotter and Peterson (1969), Maresh (1970), Gindhart (1973), and Scheuer *et al.* (1980). Most of these studies were cross-

sectional and focused on only one or two skeletal elements. The exception is Maresh's (1970), study of all six major long bones using radiographs collected longitudinally from children of European (White) ancestry during the Child Research Council's growth study, begun in Denver, CO, in 1927. However, long bone lengths were never directly measured; instead, children were laid directly on film plates, using a long source to image length (between 4 and 7 feet) to minimize the magnification effect. Maresh measured the radiographs directly, though magnification effects were estimated to be between 2 and 3 percent. Significantly, Maresh (1970) found that the measurement errors from radiographs were far less than the errors in comparable anthropometric measurements from the living. Three recent studies (Grivas and Komar 2008; Stull 2008; Warren 1999) using smaller samples confirmed the high correlation of measurements of bone lengths from autopsy radiographs to age at death within morgues. Stull (2008) found a high correlation (0.85) between radiographic femur lengths and age, and the correlation was higher than those between radiographic femur lengths and crown-heel length or weight. Grivas and Komar (2008) compared radiographic measurements to age estimates obtained using earlier standards and found significant differences due to different ancestry and secular increases.

A significant amount of time has passed since the initial publication of most of these studies, and the source data came from children born even earlier. Additionally, these studies focused on describing normal bone growth for a known age, rather than estimating age from bone lengths, which is the goal of forensic analysis. Thus, they are of limited practical use in estimating age in subadults, and cannot provide age prediction intervals. Due to secular differences in maturity rates and the temporal disparity between the reference samples and

modern groups, age estimates based on measurements will tend to be overestimated. Consequently, there are no data sources of long bone lengths for the calculation of unbiased estimates and reliable prediction ranges for modern subadult remains. Age estimation based on the available standards is of doubtful validity and reliability in a forensic context, and therefore is not *Daubert*-compliant.

Numerous other criteria for age estimates, such as the timing of epiphyseal union in various bones, the degree of development in certain bones (when the radiographic quality is sufficient), and bone shapes (rather than merely size) can be explored through examining radiograph. For example, Crowder and Austin (2005) scored epiphyseal union in the distal tibia and fibula in teenagers of different ancestry. Complex and informative relationships among age indicators, which may be useful in sex estimation, can be investigated with large samples. Additionally, more sophisticated methods such as digitization, elliptical Fourier analysis, and geometric morphometrics will likely lead to new reliable indicators of sex and ancestry, similar to Buck and Vidarsdottir's (2004) method of estimating ancestry through geometric morphometric analysis of the immature mandible.

## **Research Design and Methods**

The radiographs to be scanned are those of individuals between the fetal stage and 20 years of age, at which point the skeleton is largely mature. As mentioned in the Introduction, the magnification and distortion effects of radiography cannot be avoided. The amount of radiographic magnification primarily depends on two distances, the Source-Image Distance (SID) and Object-Image Distance (OID), as

seen in Figure 1, which illustrates the effects of x-raying remains. The standard SID has been 40 inches for quite some time. There are no standards for OID, but offices typically use a Bucky cartridge system or a similar setup that keeps the SID constant and the OID within reasonable limits, depending on soft tissue thickness. Magnification and distortion effects also depend on how far the object is from the center of the beam. The further from the center of the beam an object is, the greater the distortion because the x-rays are projected at a wider angle. Thus, an object x-rayed close to the center of the beam will appear to be smaller than if it is x-rayed further from the center of the beam (Carlton and Adler 2001).

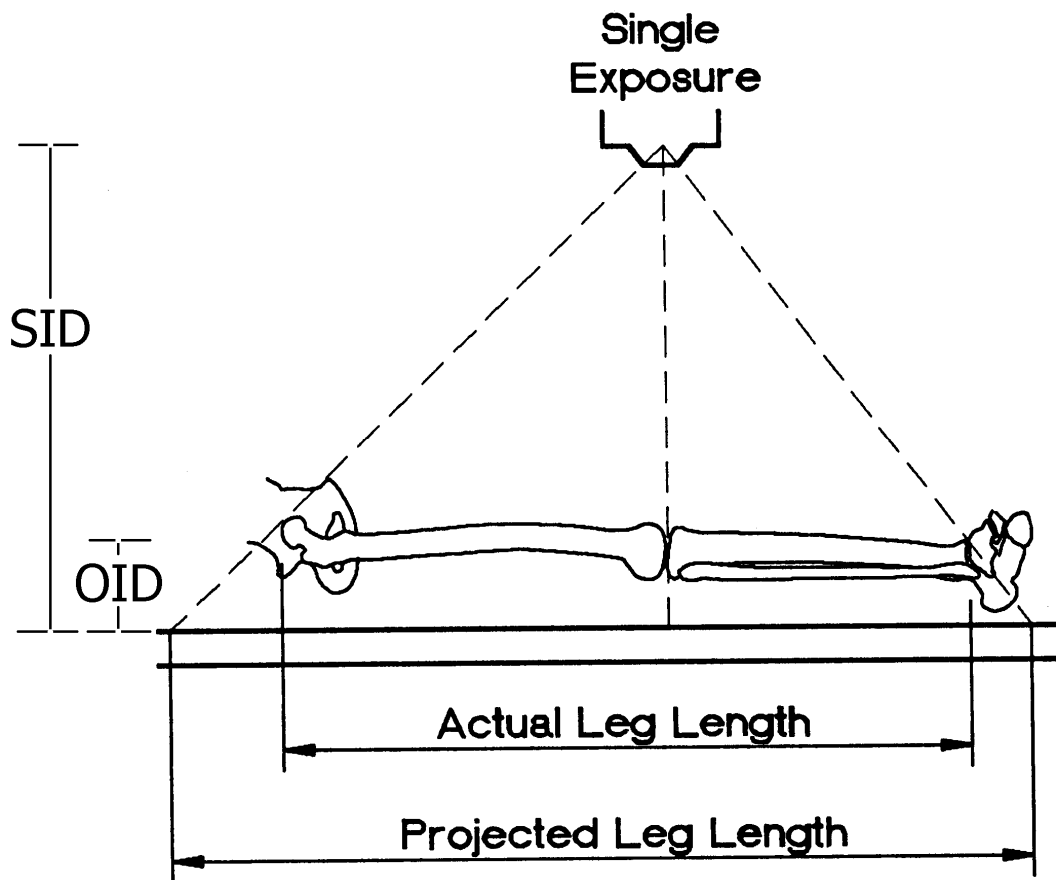


Figure 1. The magnification of bone dimensions on radiographs and the Source-Image Distance (SID) and Object-Image Distance (OID). Adapted from Carlton and Adler (2001).

While magnification and distortion effects are unavoidable in radiographs, it does not mean that they are insurmountable. To estimate the sources of measurement error in radiographs, the height and center of the x-ray beam source can be calculated using a radiographic registration device (RRD) illustrated in Figure 2. Because each RRD is a 10 mm thick piece of Plexiglas with nine 1 mm ball bearings 30 mm apart, any magnification and distortion effects will be represented in two dimensions when the RRD is projected on a radiograph, and the position of the x-ray source can be estimated using geometric formulae. Once the position of the x-ray source is calculated, measurements taken from any points on the radiograph can be adjusted for distortion and magnification effects. Ideally, each radiograph would have already been exposed with a RRD, but at each morgue the anthropologists will initially place two RRDs on the radiographic surface and expose a radiograph. If the morgue staff reports in interviews and through the questionnaire that the radiographic setup (x-ray apparatus, x-ray table, SID) has not changed recently, and if there are no obvious indications from past radiographs that the setup has changed, then the baseline radiographs should represent past radiographic conditions.

Radiographic standards are well known by radiographers, and Stull (2008) found evidence for consistently exposed radiographs in the high correlations between bone lengths and age in her study from Erie County, NY. When objects of known size (coins, straight pins, safety pins, etc.) are found in any radiographs, they will serve as a check on calculations and assumptions.

Calculation of the magnification and distortion pattern will be crucial to obtaining the best possible estimates of bone size. Measurements taken from radiographs using calipers have proven to be highly accurate, and using software such as tpsDIG (Rohlf 2006), measurement points will be registered in digitized images with even greater accuracy. When measurement points are taken from the digitized radiographs, the raw and adjusted measurements will be

calculated through another computer program that has incorporated the information from the RRD to calculate the beam position for that site. In this way, corrected point-to-point distances taken anywhere in the radiograph can be calculated.

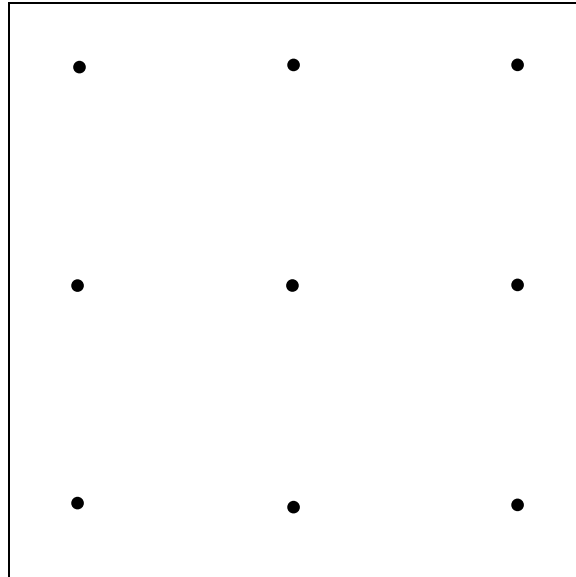


Figure 2. A radiographic registration device (RRD) consisting of a 10 mm thick piece of Plexiglas with evenly spaced ball bearings 30 mm apart and at the same depth (5 mm). When placed on the radiographic surface, its projection onto the radiograph enables calculations of the position of the x-ray source.

The other distortion factor in fleshed remains is due to the distance from the bone to the radiographic surface where the child is placed and the RRD rests, above the radiographic film. Fortunately, in most radiographs, the outline of the soft tissue can be seen and the distance from the exterior skin surface to the bone can be measured in two dimensions (parallel to the radiographic surface) and the soft tissue thickness underneath the bone can be estimated. Additionally, clinical ultrasound data from infants are widely published. The procedures for correcting for magnification and distortion due to the nature of x-ray projection and skin thickness will be verified through x-raying known length bones using padding to simulate the presence of soft tissue. As a result of preserving both raw measurements and adjusted

measurements, the measurements will be valuable both to medical examiners who estimate age using radiographs of fleshed remains and to forensic anthropologists who estimate age from dry bones.

Radiographic films are a vanishing resource. With more morgues moving to digital radiography, it is likely that many labs will destroy their radiographic film collections. At least one of the morgues contacted has already destroyed a significant number of older radiographs simply due to a shortage of storage space. Scanning radiographic films is necessary to help establish the proposed database. Like the Forensic Data Bank, if free software for age estimation is available, the medical examiners and coroners will realize that they can benefit from contributing radiographic data to the data bank. Contributing new case information will be easier after the morgue has started using digital radiography because images could be periodically copied to a DVD and mailed to the Department of Applied Forensic Sciences at Mercyhurst. The Department of Applied Forensic Sciences at Mercyhurst will provide the necessary administrative oversight and staff support to incorporate new digital information into the database.

As mentioned above, the compilation of digital radiographic information involves travel and on-site scanning and data collection. In order to choose which morgues would likely have large numbers of radiographs, U.S. demographic data were evaluated and the largest populated cities were chosen while accommodating a wide geographic distribution. This was done in order to accommodate differentially represented ancestry/ethnic groups in the American population. A contact list of 50 metropolitan areas with acting medical examiners and/or coroners was



generated, including Providence, RI, New York, NY, Boston, MA, Philadelphia, PA, Buffalo, NY, Rochester, NY, Miami, FL, Albuquerque, NM, Phoenix, AZ, Los Angeles, CA, Denver, CO, and Portland, OR.

Preliminary contacts have been made with numerous offices in order to: 1. Determine if there are enough cases with radiographs available for scanning; 2. Determine if the radiographic procedures and setup have been consistent enough to produce reliable data; 3. Assess receptiveness to visiting researchers; 4. Understand individual office protocols (e.g. paper filing versus digital, location of radiographs, procedures when x-raying subadults); 5. Evaluate the research environment (e.g. space for researchers, familiarity with required research paperwork). The vast majority of the responses have been overwhelmingly positive once it was clear that the scanning would take place in their offices and the radiographs would not leave their secured area. Also, because the proposal does not involve living persons, several offices indicated that an Institutional Review Board would likely not be necessary. Many offices have database systems that allow locating the relevant electronic records instantly. One of the contacted offices that uses digital radiography indicated that saving radiographs to DVDs and mailing them to Mercyhurst would likely be feasible. Through the telephone interview process, a more thorough survey was developed that will be mailed or faxed to each office in March 2008 and shown in the Appendix. Based on the information collected in this survey, the 20 offices with the largest subadult sample size and ancestral variety will be visited. The exact scheduling of visits will be determined from the survey because the length of each visit must be estimated in order to accommodate the number of cases in the office as well as the method of demographic data storage. An average of two weeks in each office is estimated, although smaller morgue collections will require a shorter

visit and larger morgue collections will require a longer visit. If some of the offices volunteer to send DVDs with digital radiographs through the mail, the Applied Forensic Sciences Department at Mercyhurst will mail them two RRDs and ask them to expose a digital radiograph using the devices and send it to the Department. The RRDs will be left behind with visited and participating morgues so the staff can use them in their continued work.

To ensure that only modern growth trends are evaluated, sampling will be limited to cases since 1995. Data collection in each office will begin with the most current cases and progress backwards through time. Visiting the offices will involve 1) locating relevant radiographic material, 2) recording the associated biological demographic information, and 3) high resolution scanning of radiographic images. No personally identifying information will be recorded from the decedents. All efforts will be geared toward minimal infringement upon daily morgue operations.

A pilot study conducted by the two consultants on this proposal demonstrates that the project is feasible and provides a reasonable time estimate to record and scan radiographs from a large number of cases. In the summer of 2007, the two consultants (KF and KS) were awarded internships with the Erie County Medical Examiner's Office in Buffalo, New York. Realizing the potential for research in the large collection of radiographs stored on site, the consultants returned in the fall of 2007 for systematic data collection. Over the course of three days information was collected from over 650 cases. This information included a digital photograph of every radiograph on file and age, sex, ancestry, cause and manner of death, stature, and weight were recorded. In the Buffalo office nearly two-thirds of the cases collected had demographic

information stored digitally and the remaining third had demographic information stored in paper files. During the pilot study, one consultant was responsible for photographing radiographs while the other worked to organize and prepare the radiographs. Afternoons were spent accessing both paper and digital resources for the collection of demographic information for the cases that had been photographed that day.

The process of familiarization and the level of organization encountered in each office visited will impact the length of the visit and can only be roughly estimated through the questionnaires. Minimal resources are required from each office. The principal needs are a power source, an available workspace (e.g. an empty conference room), access to demographic information (paper and/or electronic), and access to radiographs. Data collection will alternate between radiographic scanning and the collection of demographic data. With two scanning stations established, both researchers will be able to collect data simultaneously. With a limited amount of time in each office, it is clearly necessary to maintain concurrent progress of demographic data collection and radiographic scanning.

When recorded, the file names will be modified to preserve confidentiality and to protect the anonymity of the original case number. Privacy certification and all other research requirements will be met to the demands of each individual office. A master copy associating the original case number with a pseudonumber will be retained should any reevaluation prove necessary. Radiographs will be scanned onto laptops, where they will be named and saved, and backed up to multiple external hard drives. Files containing the scanned images and the biological information will be backed up on these hard drives and mailed weekly to Mercyhurst

College for incorporation into the database. This will ensure protection of the data as well as the continual flow of the data collection and storage processes.

Once received at Mercyhurst College these data will be uploaded onto a workstation devoted entirely to data storage and necessary backup accommodations. A graduate student in the Masters program in Biological and Forensic Anthropology at Mercyhurst College will be hired part-time as a research assistant to help organize digital files, perform clerical duties, arrange travel, and schedule office visits as needed.

Scanning takes more time than taking a digital photograph, as in the pilot study, and it is estimated that the researchers together should be able to scan radiographs from a minimum of 300 cases per week. The anticipated approximate total sample size is 13,000 individuals, a large sample that will be needed when divided up by age, sex, and ancestry/ethnicity subsamples. Having a large sample will also allow independent testing of future research results based on the database. Researchers will be able to evaluate published findings on their own, greatly improving the validity and reliability of new methods and conclusions. Involvement of offices from several regions will remove possible regional biases and produce a diversity of ancestry groups more representative of the American population as a whole.

### **Implications for Criminal Justice Policy and Practice**

This grant will enable much better predictions for age at death in subadult remains, especially with the use of the free software, which will lead to more identifications of subadult remains and therefore, more identified perpetrators. Continued data collection will allow the

forensic professional to keep up with secular changes and with locally changing ethnic/ancestral compositions. The further development of additional methods for estimating the biological profile will be facilitated through further research of the widely available database.

### **Management Plan and Organization**

The principal investigator of this project is Dr. Stephen Ousley, Assistant Professor in the Department of Applied Forensic Sciences, Mercyhurst College. His primary role will be overall project management and the organization and configuration of the database. His experience in human osteology, biostatistics, computer programming, supervision, project management, and databases uniquely qualifies him for these tasks. He spent eight years as database manager of the Forensic Data Bank, has formal training in database design and database administration, and remains a database consultant to the Department of Anthropology at the University of Tennessee and for two archaeological companies. He is the computer programmer of Fordisc (Jantz and Ousley 1993, 2005; Ousley and Jantz 1996), a widely used computer program that applies multivariate statistics to estimate sex, ancestry, and stature from unknown skeletal remains. For the nine years before coming to Mercyhurst College, Dr. Ousley oversaw the osteological documentation process in the Repatriation Office at the National Museum of Natural History, Smithsonian Institution, where he supervised eight employees and contractors.

The proposal will require two years months for completion, though the bulk of all work will be completed within 16 months. In March of 2008, the questionnaires will be mailed to up to 75 Medical examiner and Coroner offices. The information from the questionnaires will be compiled in the summer of 2008. The first two weeks of the project will be spent purchasing materials, scheduling the most pressing visits, designing and preparing the database for storage,

and completing a comprehensive run through to ensure proficient integration of the technical equipment into the proposed protocol. For sixteen months thereafter, two full-time Masters-degree level anthropologists will be visiting morgues, scanning radiographs, collecting demographic data, entering data into the database, performing error checking, and conducting research using the data.

At the close of the first two weeks the office visits will commence. This process will begin in the Erie County Medical Examiners Office in Buffalo, NY. This office was chosen as the initial destination due to the researchers' familiarity with the environment as well as the proximity to the PI. An on-site assessment will be conducted to insure efficient workflow, optimal information extraction, and minimization of data entry errors. Data collection will then continue at the next two scheduled offices in the Northeast US, followed by a return visit to Mercyhurst College to convene with the PI to address any technical or procedural concerns that may arise. From this point on visits will be planned in geographic clusters in order to minimize travel time and expenses. In all, twenty morgues will be visited in just over a year, with an average of two weeks allocated for each office. Transportation by air will be the primary method of long distance travel, with visits to distant cities close to each other aided by rental vehicles, and offices in close proximity to Erie or one another will be visited by vehicle. Portions of the first year will be dedicated to data entry of radiographic measurements, age at death estimation based on the measurements, and preparation of abstracts for three professional meetings.

During the second year of the project, approximately four months will be devoted to supplemental visits to several morgues previously visited, further data entry, developing age

estimates using bone measurements, software development, and dissemination to scientific communities. The supplemental visits, primarily follow-ups to the offices with the most new cases, are needed in order to collect the most recent cases, collect information from any older cases missed in the first visit, and to continue the collection of radiographic data using RRDs for further research on calibrating radiographic data. An unvisited morgue may be visited for data collection instead of a previously visited one depending on questionnaire responses and the number of new cases in the previously visited offices. Data entry will be finished during this period, as will the software to aid in recording measurements from radiographs and use them to estimate age. Dissemination in the form of presentations and posters at the American Academy of Forensic Sciences and the American Association of Physical Anthropologists will occur in this period as well. The final presentations will be given at the National Association of Medical Examiners meeting in October of 2010.

### **Dissemination**

After the grant is finished, a copy of the database, software, and images will be sent to the NIJ, and approximately ten additional copies will be sent to other institutions, primarily large medical examiner offices and universities with well-established forensic programs. The database, research resulting from it, and software will be mentioned on a Mercyhurst web site and the database will be made available on DVD to other interested institutions at cost. The software will be available for free on the web site and the RRD will be made available for free upon request, and at cost after all provided for in the proposal (40) have been distributed. It is a certainty that new methods of analyzing subadult remains will come from the database, as has happened with the Forensic Data Bank. Additional software applications will be practical once

new methods for estimating age, sex, and ancestry are established, and can be incorporated into Fordisc or created as another computer program.

Dissemination is also planned at professional conferences through at least six presentations and posters at three professional meetings in 2010 (at the American Academy of Forensic Sciences, American Association of Physical Anthropologists, and National Association of Medical Examiners meetings). At least two publications in peer-reviewed journals will be prepared sometime after the grant is finished.

Through the use of the database and software, and presentations and publications, it is anticipated that in the future, medical examiners and coroners will voluntarily contribute radiographs to the database. Compiling and mailing digital radiographs on a DVD will be an especially simple way to contribute new information. Scanned radiographs of subadult teeth from dentists are another obvious addition to the database. Having a central repository for radiographic data will greatly enhance its applicability and scope. The Department of Applied Forensic Sciences at Mercyhurst will provide the necessary administrative oversight and staff support to incorporate new digital information into the database.



## Appendix 1: References

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## **Appendix 2. List of Key Personnel**

Stephen Ousley, Ph.D., is an assistant professor in the Department of Applied Forensic Sciences at Mercyhurst College. He earned his physical anthropology B.A. degree at the University of Maryland, College Park, and his M.A. and Ph.D. Degrees at the University of Tennessee, Knoxville. As a graduate research assistant, he worked as database administrator and skeletal data collector for the Forensic Data Bank, a repository of skeletal data from forensic cases from around the country. His Master's thesis dealt with the peopling of the New World and Native American anthropometrics and his dissertation was a quantitative genetics analysis of fingerprints. For nine years he was the Director of the Repatriation Osteology Laboratory at the National Museum of Natural History, Smithsonian Institution, one of the largest osteological documentation programs in the US. He is best known for his work in quantitative methods in forensic anthropology, especially the computer program Fordisc, coauthored with Richard Jantz of the University of Tennessee, Knoxville. His other research interests include geometric morphometrics, skeletal biology, human variation, and quantitative genetics.

### **Appendix 3. Project Timeline**

(based on arbitrary start date as well as approximation of average visit duration).

#### *Abbreviations used:*

*MECO – Medical Examiner/Coroners Office*

*AAFS – American Academy of Forensic Sciences*

*AAPA – American Association of Physical Anthropologists*

*NAME – National Association of Medical Examiners*

Sunday, October 15, 2008	Funding commences Travel arrangements planned Acquisition of equipment and hardware setup Trial run of data collection
Sunday, November 1, 2008	Data collection begins with Erie County Medical Examiners Office, Buffalo, NY On-site evaluation of data collection protocol
Sunday, November 15, 2008	Second MECO visit begins Database design and data entry programming begins
Sunday, November 30, 2008	Third MECO visit begins
Dec 13, 2009 – Jan 10, 2010	Review radiographs collected and protocol Review scheduling for the next six months Data collection and data entry into database using program Database adjustments and corrections
Sunday, January 11, 2009	Fourth MECO visit begins
Sunday, January 25, 2009	Fifth MECO visit begins
Sunday, February 8, 2009	Sixth MECO visit begins
Sunday, February 22, 2009	Seventh MECO visit begins
Sunday, March 8, 2009	Eighth MECO visit begins
Sunday, March 22, 2009	Ninth MECO visit begins
Sunday, April 12, 2009	Tenth MECO visit begins
Sunday, April 26, 2009	Eleventh MECO visit begins
Sunday, May 10, 2009	Twelfth MECO visit begins
Sunday, May 31, 2009	Thirteenth MECO visit begins

June 14 – July 25, 2009	Data collection and data entry Data analysis, preparation and submission of meeting abstracts
Sunday, July 26, 2009	Fourteenth MECO visit begins
Sunday, August 9, 2009	Fifteenth MECO visit begins
Sunday, August 23, 2009	Sixteenth MECO visit begins
Sunday, September 13, 2009	Seventeenth MECO visit begins
Sunday, September 27, 2009	Eighteenth MECO visit begins
Sunday, October 11, 2009	Nineteenth MECO visit begins
Sunday, October 25, 2009	Twentieth MECO visit begins
Nov 8 - Jan 9, 2010	Data entry, data analysis, and meeting preparation
Sunday, January 10, 2010	First MECO supplemental visit begins
Sunday, January 17, 2010	Second MECO supplemental visit begins
Sunday, January 24, 2010	Third MECO supplemental visit begins
Sunday, January 31, 2010	Fourth MECO supplemental visit begins
February 7 –Feb 20, 2010	Data entry, data analysis, and meeting preparation
February 21-27, 2010	Present results at AAFS Annual Professional Meetings
Feb 28 – April 10, 2010	Data analysis, software development, meeting preparation
April 11 – 17, 2010	Present results at AAPA Annual Professional Meetings
April 18-30, 2010	Data analysis, software development finished
October 10 – 16, 2010	Present results at NAME Annual Professional Meetings

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- Analysis, Software, Research
- Data Collection
- Dissemination

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- Analysis, Software, Research
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# 2010

<u>January</u>	<u>February</u>	<u>March</u>
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- Analysis, Software, Research
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## Appendix 4. Preliminary Research Questionnaire

To be mailed/faxed to all potential and involved Medical Examiner/Coroners Offices

1. Who is the contact person for research conducted at your facility?

Name:

Position:

Work Hours:

Phone number:

Email:

2. Is your facility attached to or associated with a hospital or school?
3. Does your staff perform radiography or is it done by a hospital or other facility?
4. How often does your office autopsy individuals under 18?
5. Are full body radiographs taken of individuals under 18?
6. What techniques do you use to estimate age in unidentified individuals under approximately 20 years of age?
7. Do you have standard radiographic protocols for individuals under 20 years of age? (i.e. only traumatic cases versus all individuals entering the office)
8. Do you utilize a Bucky cartridge system? If not, please describe how film is positioned for x-raying:
9. Do you incorporate a scale into your radiographs?

10. Are your office radiographs stored inside the office?
  
11. Do you have extra available work area, such as an empty conference room or empty office?
  
12. Approximate percentage of film and radiographs taken since 1995:  
Film:  
Digital:
  
13. If you are still using radiographic film, when will your facility be converting to digital radiography?
  - a. Within six months
  - b. Within one year
  - c. Within 5 years
  - d. Unknown
  
14. Approximate percentage of case information recorded on paper vs. on a computer in the last 10 years:  
  
Paper:  
Computer:
  
15. If your case information is stored on computer, what type of software does your office use (e.g. PathAssist)?
  
16. Are you aware of any other facilities or individuals that might have a collection of additional radiographs?

## CURRICULUM VITAE

**Stephen D. Ousley**

**Address:** Department of Anthropology/Archaeology  
Mercyhurst College  
501 East 38<sup>th</sup> St.  
Erie, PA 16546  
(814) 824-3116

### **Education:**

- 1979-1985 University of Maryland  
College Park, Maryland  
B.A., Anthropology, 5/1985
- 1985-1986 Universität Bremen  
Bremen, Germany  
Exchange student  
German language and history
- 1989-1997 University of Tennessee (UTK)  
Knoxville, Tennessee  
Graduate Program in Anthropology  
M.A. 12/1993, Minor in Statistics  
Ph.D. 8/1997

### **Professional Experience**

- 7/2007- present Assistant Professor, Department of Anthropology/Archaeology, Mercyhurst College, Erie, PA.
- 11/2007-present Anthropological consultant, Statistical Research, Inc, Tucson, AZ. I review and make recommendations regarding the analysis of human remains encountered in excavations.
- 5/2003 – present Computer Programming Consultant, AMEC, Louisville, Kentucky.  
Using Delphi for Windows and Sybase Adaptive Server Anywhere, I program relational database applications for artifact data from archaeological sites. I develop computer programs for data entry and inventory control, reports, and data analysis for archaeologists. Dr. Henry McKelway, principal investigator.
- 1/98 – 6/2007 Laboratory Director, Repatriation Osteology Laboratory, Office of Repatriation, Department of Anthropology, National Museum of Natural History, Smithsonian Institution.  
I managed the program to capture information from skeletal remains subject to repatriation as the Laboratory Director. I supervised three full-time employees and technically directed up to six contractors in the documentation and inventory of human remains. I wrote new computer programs for data entry by the laboratory staff, and for the analysis and reporting of osteological data in the laboratory's databases. I wrote and edited osteological reports and documentation data. I performed statistical analyses on data collected by the laboratory, and prepared written reports and presentations on all aspects of the repatriation process. I also assessed material needs and ordered supplies for the laboratory.

- 11/96 – 1/2005 Computer Programming Consultant, Cultural Resource Analysts, Lexington, Kentucky. Using Delphi for Windows, I programmed relational database applications for artifact data from archaeological sites as a consultant. I developed computer programs for data entry and inventory control, reports, and data analysis for archaeologists. Andrew Bradbury, principal investigator.
- 8/89-7/96 Graduate Research Assistant: Database Manager, Database Programmer, Statistical Analyst, and Data Collector, Department of Anthropology, University of Tennessee, Knoxville.  
I managed the Forensic Data Bank, which contains demographic and biological information from modern humans. Upon arrival, restructured all databases into a better relational framework and developed many database applications including data entry, extraction, and graphing programs. Defined, coordinated, and implemented more consistent data collection procedures. Conducted numerous multivariate statistical analyses of human biological data for professors and for my own publications. Advised numerous faculty on hardware and software purchasing decisions. Dr. Richard Jantz, supervising professor.
- 6/95 - 8/96 Computer Programming Consultant, Wilbur Smith Associates, Lexington, Kentucky. Using Paradox DOS, I programmed relational database applications for artifact data from archaeological sites as a consultant. I developed programs for data entry and inventory, data extraction, and reports. I consulted with and trained data entry personnel. Susan Andrews, principal investigator.
- 9/94-5/96 Database Programmer, Department of Anthropology, The University of Tennessee. I developed relational databases, data entry applications, and inventory analysis programs in Paradox DOS as part of a National Science Foundation grant to computerize the department's zooarchaeology collection. Dr. Walter Klippel, principal investigator.
- 3/94-5/94 Database Programmer, Department of Anthropology, The University of Tennessee. I developed relational databases and data entry applications using Paradox DOS as part of a National Science Foundation grant to computerize the department's American Indian skeletal collection. Dr. Lyle Konigsberg, principal investigator.
- 8/93-9/93 Database Programmer and Statistical Consultant, Department of Anthropology, Smithsonian Institution.  
I reorganized dental databases in a relational framework and developed menu-driven data analysis and reporting programs using Paradox DOS. Dr. Douglas Owsley, principal investigator.
- 5/91-8/91 Database Programming Consultant, University of Tennessee Transportation Center. I developed databases and programmed data entry and analysis programs in Paradox DOS for artifacts from excavated archaeological sites. Charles Bentz, principal investigator.
- 10/87-8/89 Collections Manager and Database Programming Specialist, Department of Neuropathology, Armed Forces Institute of Pathology, Washington, DC.  
I assembled, organized, and computerized the Blackburn-Neumann Collection, consisting of medical records, preserved tissue, and glass slides from over 15,000 autopsies. I developed data entry programs in Lotus 123 and programmed and implemented a database application in Paradox DOS for researchers visiting the AFIP who wished to review, select, and study the materials of the collection. I supervised one full-time and one part-time employee. Dr. Joseph Parisi, supervisor.

- 3/87-10/87 Museum Technician, Natural History, Smithsonian Institution.  
I inventoried, curated, stored, and transferred ethnographic collection objects from the Department of Anthropology to the Museum Support Center. Greta Hansen, supervisor.
- 6/82-7/82 Physical Anthropologist, Caesarea Maritima, Israel, summer excavations.  
I excavated and analyzed human and animal skeletal remains and wrote a summary report on them. Dr. Kenneth Holum, Department of History, University of Maryland, principal investigator.

### **Professional Training**

- 1989-1996 Graduate Research Assistant for Dr. Richard Jantz, Department of Anthropology, UTK.
- 7/1998 Introduction to Delphi. Softbite International.
- 7/1998 Delphi Power Programming. Softbite International.
- 9/1998 Supervisory Training Program, Smithsonian Institution.
- 7/2000 Sybase Adaptive Server Anywhere Fundamentals. Sybase Training.
- 8/2000 Relational Databases: Design, Tools and Techniques. Learning Tree International.
- 9/2001 Physical Database Design. Sybase Training.
- 7/2004 Categorical Data Analysis. Statistical Horizons.

### **Professional Service**

- 1996-present Occasional reviewer of submitted articles, American Journal of Physical Anthropology.
- 2005-2007 President, American Dermatoglyphics Association

### **Publications**

- 1991 Sledzik, Paul S., and Stephen D. Ousley  
Analysis of Six Documented Vietnamese Trophy Skulls. *Journal of Forensic Sciences* 36: 520-532.
- 1993 Jantz, R.L., and S.D. Ousley  
*FORDISC 1.0: Computerized Forensic Discriminant Functions*. The University of Tennessee, Knoxville.
- 1993 Ousley, S.D.  
Drops, Trickle, Waves, and Tides: North Pacific Anthropometrics and the Peopling of North America. Master's Thesis, The University of Tennessee, Knoxville.

- 1994 Moore-Jansen, P.M., Ousley, S.D., and R.L. Jantz  
Data Collection Procedures for Forensic Skeletal Material. Third Edition. The University of Tennessee, Knoxville.
- 1994 Owsley, D.W., Gill, G., and S.D. Ousley  
Biological Effects of European Contact on Easter Island. In: *In the Wake of Contact: Biological Responses to Conquest*, C.S. Larson and G. Milner, eds. New York: Wiley-Liss, 161-177.
- 1995 Konigsberg, L.W., and S.D. Ousley  
Multivariate Quantitative Genetics of Anthropometric Traits from the Boas Data. *Human Biology* 67:481-498.
- 1995 Kramer, A., Donnelly, S.M., Kidder, J.H., Ousley, S.D., and S.M. Olah  
Cranio-metric Variation in large-bodied Hominoids: Testing the Single Species Hypothesis for Homo Habilis. *Journal of Human Evolution* 29: 443-462.
- 1995 Ousley, S.D.  
Relationships between Eskimos, Indians, and Aleuts: Old Data, New Perspectives. *Human Biology* 67:427-458.
- 1995 Ousley, S.D.  
Should We Estimate Biological or Forensic Stature? *Journal of Forensic Sciences* 40:768-773.
- 1995 Sherwood, S.C., and S.D. Ousley  
Quantifying Microartifacts using a Personal Computer. *Geoarchaeology* 10: 423-428.
- 1996 Ousley, S.D., and R.L. Jantz  
*FORDISC 2.0: Personal Computer Forensic Discriminant Functions*. The University of Tennessee, Knoxville.
- 1997 Ousley, S.D.  
The Quantitative Genetics of Epidermal Ridges Using Multivariate Maximum Likelihood Estimation. Doctoral Dissertation, The University of Tennessee, Knoxville.
- 1997 Ousley, S.D., and R.L. Jantz  
The Forensic Data Bank: Documenting Skeletal Trends in the United States. In: *Forensic Osteology* (Second Edition), K. Reichs, ed. Springfield, IL: C.C. Thomas, pgs. 297-315.
- 2000 Ousley, S.D.  
Boas, Brinton, and the Jesup North Pacific Expedition: The Return of the Americanoids. *European Review of Native American Studies*, Winter 2000, pgs. 35-47.
- 2001 Ousley, S.D., and R.L. Jantz  
500 Year Old Questions, 100 Year Old Data, Brand New Computers: Biological Data from the Jesup North Pacific Expedition and the Paradox of the "Americanoid" Theory. In: *Gateways: Exploring the Legacy of the Jesup North Pacific Expedition, 1897-1902*, I. Krupnik and W. Fitzhugh, eds. Washington: Arctic Studies Center, pgs. 257-277.
- 2001 Logan, M.H., and S.D. Ousley  
Hypergammy, Quantum, and Reproductive Success: The Lost Indian Ancestor Reconsidered. In: *Anthropologists and Indians in the New South*, J.A. Paredes and R. Bonney, eds. Birmingham,

AL: University of Alabama Press, pgs. 184-202.

- 2001 Ousley, S.D.  
Lessons Learned from the Repatriation Program at the National Museum of Natural History, Smithsonian Institution. In: *International Colloquium on the First Americans*, Kyoto, Japan. pgs. 16-19.
- 2001 Ousley, S.D., and A. McKeown  
Three Dimensional Digitizing of Human Skulls as an Archival Procedure. In: *Human Remains: Conservation, Retrieval and Analysis*, E. Williams, ed. BAR International Series 934. Oxford: Basingstoke Press, pgs. 173-184.
- 2004 Cohn, R.C., Myers R.W., and S.D. Ousley. *Clinical Encephalography: A Computerized Approach*. PS&E, Silver Spring, MD.
- 2004 Hollinger, R.E., Eubanks E., and S.D. Ousley. *Inventory and Assessment of Human Remains and Funerary Objects from the Point Barrow Region, Alaska, in the National Museum of Natural History, Smithsonian Institution*. Repatriation Office, National Museum of Natural History, Smithsonian Institution, Washington, D.C.
- 2005 Arbolino, R.D., Ousley S.D., and E.B. Jones. *Reassessment of the Cultural Affiliation of Human Remains and Funerary Objects from Seaside, Oregon at the National Museum of Natural History, Smithsonian Institution*. Repatriation Office, National Museum of Natural History, Smithsonian Institution, Washington, D.C.
- 2005 Jantz, R.L., and S.D. Ousley (2005) *FORDISC 3: Computerized Forensic Discriminant Functions*. Version 3.0. The University of Tennessee, Knoxville.
- 2005 Hollinger, R. E., Botic, C., and S.D. Ousley. *Inventory and Assessment of Human Remains Potentially Affiliated with the Northwestern Band of Shoshone in the National Museum of Natural History, Smithsonian Institution*. Repatriation Office, National Museum of Natural History, Smithsonian Institution, Washington, D.C.
- 2005 Ousley, S.D., Billeck, W.T., and R.E. Hollinger. Federal Repatriation Legislation and the Role of Physical Anthropology in Repatriation. *Yearbook of Physical Anthropology* 48: 2-32.
- 2006 Hollinger, R. Eric, and Stephen Ousley. *Inventory and Assessment of Human Remains Potentially Affiliated with the Pembina Chippewa in the National Museum of Natural History, Smithsonian Institution*. Repatriation Office, Department of Anthropology, Smithsonian Institution, Washington DC.
- n.d. Hollinger, R.E., Ousley, S.D., and C. Utermohle. The Thule Migration: A New Look at the Archaeology and Biology of the Point Barrow Region Populations. In: *The Northern World AD 900-1400: The Dynamics of Climate, Economy, and Politics in Hemispheric Perspective*, H. Maschner and J. Savelle, eds. The University of Utah Press, Salt Lake City (in press).



## Presented Papers/Posters

- 1990 Ousley, S.D., and P.S. Sledzik  
Analysis of Six Documented Vietnamese Trophy Skulls. Paper presented at the 42<sup>nd</sup> Annual Meeting of the American Academy of Forensic Sciences, Cincinnati, February 19-24, 1990.
- 1992 Ousley, S.D., and R.L. Jantz  
The Forensic Data Bank: Some results after 5 years and 1000 cases. Paper presented at the 44<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, New Orleans, February 17-22.
- 1992 Jantz, R.L., and S.D. Ousley (presenting author)  
Anthropometry of North Pacific Populations: The Potential of Jesup I Data. Paper presented at the First International Congress of Arctic Social Sciences, Quebec City, October 28-31.
- 1993 Konigsberg, L.W., and S.D. Ousley  
Multivariate Quantitative Genetics of Anthropometrics from the Boas Data. Paper presented at the 62<sup>nd</sup> Annual Meeting of the American Association of Physical Anthropologists, Toronto, April 14-17.
- 1993 Alexander, A.E., and S.D. Ousley  
Multivariate Analysis of Manubrio-Sternal Measurements. Paper presented at the 45<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, Boston, February 15-20.
- 1993 Ousley, S.D., and R.L. Jantz  
Postcranial Racial Discriminant Functions from the Forensic Data Bank. Paper presented at the 45<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, Boston, February 15-20.
- 1993 Ousley, S.D.  
Anthropometric Relationships Between Native Americans and Siberians: The Post-Beringia Connection. Paper presented at the 62<sup>nd</sup> Annual Meeting of the American Association of Physical Anthropologists, Toronto, April 14-17.
- 1994 Ousley, S.D.  
Should we Estimate Biological or Forensic Stature? Presented at the 46<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, San Antonio, February 14-19.
- 1994 Ousley, S.D.  
New Perspectives on Eskimo and Aleut Relationships. Paper presented at the 63<sup>rd</sup> Annual Meeting of the American Association of Physical Anthropologists, Denver, March 29 - April 2.
- 1996 Jantz, R.L., and S.D. Ousley (presenting author)  
The Future of the Forensic Data Bank: New Data, New Technologies. Paper presented at the 48<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, Nashville, February 19-24.
- 1997 Ousley, S.D.  
Boas, Brinton, and the Siberians: The Triumph of the Americanoids. Paper presented at: "Constructing Cultures Then and Now: A Centenary Conference Celebrating Franz Boas and the Jesup North Pacific Expedition 1897-1902", The American Museum of Natural History, New York, November 13-17.

- 1998 Ousley, S.D.  
The Quantitative Genetics of Dermatoglyphics: Variances, Covariances, and Developmental Integration. Paper presented at the 67<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Salt Lake City, March 31 - April 4.
- 1999 Ousley, S.D.  
Three-Dimensional Digitizing of Human Skulls as an Archival Procedure. Paper presented at the conference "Human Remains: Conservation, Retrieval and Analysis", Williamsburg, VA, November 7-10.
- 2000 Ousley, S.D.  
New Approaches to Human Variation and Forensic Anthropology (including Repatriation). Paper presented at the 52<sup>nd</sup> Annual Meeting of the American Academy of Forensic Sciences, Reno, NV, February 20-26.
- 2000 Ousley, S.D., Owsley, D.W., and D. H. Mulhern  
Lost and Found in the Museum: Repatriation, Ancestry, Ethnicity, and History. Poster presented at the 68<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, San Antonio, TX, April 12-15.
- 2001 Ousley, S.D.  
Lessons Learned from the Repatriation Program, National Museum of Natural History, Smithsonian Institution. Paper presented at the International Colloquium on the First Americans, International Research Center for Japanese Studies, Kyoto, Japan, January 9-11.
- 2001 Ousley, S.D., and A. E. Berger  
Using Postcranial Discriminant Functions to Address Museum, Repatriation, and Other Forensic Questions. Poster presented at the 53<sup>rd</sup> Annual Meeting of the American Academy of Forensic Sciences, Seattle, WA, February 19-24.
- 2001 Mann, M.M., and S.D. Ousley  
Using Nontraditional Craniometrics to address Museum, Repatriation, and other Forensic Questions. Paper presented at the 53<sup>rd</sup> Annual Meeting of the American Academy of Forensic Sciences, Seattle, WA, February 19-24.
- 2001 Houck, M., Ubelaker, D.H., and S.D. Ousley  
D.B. or not D.B.? That is the Question. Paper presented at the 53<sup>rd</sup> Annual Meeting of the American Academy of Forensic Sciences, Seattle, WA, February 19-24.
- 2001 Ousley, S.D., and W.T. Billeck  
Assessing Tribal Identity in the Plains using Nontraditional Craniometrics (Interlandmark Distances). Poster presented at the 70<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Kansas City, MO, March 28-31.
- 2001 Mulhern, D.M., Ousley, S.D., and E.B. Jones  
The Effects of Pathology on Biological Affiliation. Poster presented at the 70<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Kansas City, MO, March 28-31.

- 2002 Ousley, S.D., and R.L. Jantz  
Social Races and Human Populations: Why Forensic Anthropologists are Good at Identifying Races. Paper presented at the 71<sup>st</sup> Annual Meeting of the American Association of Physical Anthropologists, Buffalo, NY, April 10-13.
- 2003 Ousley, S.D., Seebauer, J.L., and E.B. Jones  
Forensic Anthropology, Repatriation, and the "Mongoloid" Problem. Paper presented at the 55th Annual Meeting of the American Academy of Forensic Sciences, Chicago, IL, February 17-22.
- 2003 Ousley, S.D., and A. McKeown  
A Comparison of Morphometric Data and Methods in Classification. Poster presented at the 73<sup>rd</sup> Annual meeting of the American Association of Physical Anthropologists, Phoenix, AZ, April 23-26.
- 2003 Ousley, S.D., and W.T. Billeck  
The Value Of Recording Metric Variation From Remains Subject To Repatriation. Paper presented at the Fifth World Archaeological Congress, Washington, DC, June 21-26.
- 2003 Ousley, S.D.  
Race: Forensic vs. Biological Anthropology. Paper presented at the 102nd Annual American Anthropological Association Meeting, Chicago, IL, November 19-23.
- 2003 Weisensee, K, Jantz, R.L., Ousley, S.D., and D. Sivakova  
Relationships of Slovak Roma Populations Assessed from Finger Ridge Counts. Poster presented at the 73<sup>rd</sup> Annual meeting of the American Association of Physical Anthropologists, Phoenix, AZ, April 23-26.
- 2004 Hefner, J.T., Ousley, S.D., and M.W. Warren  
An Historical Perspective on Nonmetric Traits: Hooton and the Harvard List. Paper presented at the 56th Annual meeting of the American Academy of Forensic Sciences, Dallas, TX.
- 2005 Dudar, J.C., and S.D. Ousley  
Diagnosis of Anencephaly, a Common Lethal Neural Tube Defect, From Taphonomically Altered Fetal or Neonatal Skeletal Remains. Paper presented at the 57th Annual Meeting of the American Academy of Forensic Sciences, New Orleans, LA, February 21-26.
- 2005 Freid, D., Spradley, M.K., Jantz, R.L., and S.D. Ousley. The Truth is Out There: How NOT to use FORDISC. Poster presented at the 74<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Milwaukee, WI, April 6-9.
- 2005 London, M.R., Wilczak, C.A., Dudar, J.C., and S.D. Ousley. Congenital and developmental defects of the vertebral column in samples from Hawikku and Puye, New Mexico. Poster presented at the 74<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Milwaukee, WI, April 6-9.
- 2005 Ousley, S.D., and J.T. Hefner  
Morphoscopic Traits and the Statistical Determination of Ancestry. Paper presented at the 57th Annual Meeting of the American Academy of Forensic Sciences, New Orleans, LA, February 21-26.

- 2005 Ousley, S.D., Hollinger, R.E., and C.J. Utermohle  
Northern Arctic Prehistory II: The Thule Migration in Light of New Morphometric Data. Paper presented at the 69<sup>th</sup> Annual Meeting of the Society for American Archaeology, Montreal, March 31 - April 4, 2004.
- 2005 Ousley, S.D., and R.L. Jantz  
The Next FORDISC: FORDISC 3. Paper presented at the 57<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, New Orleans, LA, February 21-26.
- 2005 Ousley S.D. Biological anthropology in the Repatriation Osteology Laboratory, National Museum of Natural History, Smithsonian Institution. Paper presented at the 70<sup>th</sup> Annual Meeting of the Society for American Archaeology, Salt Lake City, March 30-April 3.
- 2005 Ousley, S.D. Physical Anthropology as Applied Anthropology in the Repatriation Process. Paper presented at the 2005 meeting of the Society for Applied Anthropology, Santa Fe, NM, April 5-8.
- 2005 Wilczak, C.A., and S.D. Ousley. Questioning the relationship of cranial deformation to ossicle formation: Results from Hawikku. Poster presented at the 74<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Milwaukee, WI, April 6-9.
- 2006 Hefner, J.T., and S.D. Ousley  
Morphoscopic Traits and the Statistical Determination of Ancestry II. Paper presented at the 58<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, Seattle, WA, February 20-25.
- 2006 Ousley, S.D. Morphological, Metric, and Morphometric Variation in the Midface. Paper presented at the 58<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, Seattle, WA, February 20-25.
- 2006 Ousley, S.D., Hollinger, R.E., and C. Utermohle. Northern Arctic Population Structure, History, and Migrations in Light of New Data and Methods. Paper presented at the 75<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Anchorage, AK, March 8-11.
- 2007 Ousley, S.D., and J.E. Byrd. New Statistical Approaches to Forensic Classifications: Multi-Stage Discriminant Function Analysis. Paper presented at the 59<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, San Antonio, TX, February 19-24.
- 2007 Ousley, S.D., and N. Sauer. The Future of Assessing Ancestry. Paper presented at the 59<sup>th</sup> Annual Meeting of the American Academy of Forensic Sciences, San Antonio, TX, February 19-24.
- 2007 Ousley, S.D., and R.L. Jantz. Exploring Human Craniometric Variation: Statistical, Mensural, Biological, and Historical Considerations. Paper presented at the 76<sup>th</sup> Annual Meeting of the American Association of Physical Anthropologists, Philadelphia, PA, March 28-31.

### **Teaching Experience**

- 1995 Instructor, Department of Anthropology, University of Tennessee: Anthropology 210, Introduction to Biological Anthropology, Summer Evening School.
- 1996 Instructor, Department of Anthropology, University of Tennessee: Anthropology 210, Introduction to Biological Anthropology, Summer Evening School.

## Workshops / Invited Lectures

- 1998 Multivariate Methods in Forensic Anthropology. Lecture as part of the Eleventh Annual National Museum of Health and Medicine/Armed Forces Institute of Pathology Forensic Anthropology Course. National Museum of Health and Medicine, Washington, DC, May 12.
- 2001-2005 Mercyhurst Short course "Laboratory Methods in Forensic Anthropology". Lecture titled "Multivariate Methods in Forensic Anthropology" (6 hours).
- 2005-2006 Lectures on multivariate statistics and forensic anthropology, Mercyhurst College program in Applied Forensic Science (7 hours).
- 2003 Human Variation and Human Races: Results from Biological and Forensic Anthropology. Smithsonian Senate of Scientists Dinner Forum, Smithsonian Institution, Washington, DC, October 1.
- 2005 Jantz, R.L., and S.D. Ousley (co-chairs)  
The Uses and Abuses of Statistics and FORDISC in Forensic Anthropology. Workshop given at the 57th Annual Meeting of the American Academy of Forensic Sciences, New Orleans, LA, February 22, 7 hours.
- 2005 Jantz, R.L., and S.D. Ousley (co-chairs)  
The Uses and Abuses of Statistics and FORDISC in Forensic Anthropology. Workshop given at the 2005 Mountain, Swamp, and Beach forensic anthropologists meeting, Chattanooga, TN, September 4, 7 hours.
- 2006 Standardizing the Standards: Recording Paleopathological Observations using the Smithsonian's Computerized Data Entry System (with Christopher Dudar, Marilyn London, Gwyn Madden, Dawn Mulhern, and Cynthia Wilczak). Annual Meeting of the Paleopathology Association, Anchorage, AK, March 7.
- 2007 Jantz, R.L., and S.D. Ousley (co-chairs)  
The Uses and Abuses of Statistics and FORDISC in Forensic Anthropology. Workshop given at the 59th Annual Meeting of the American Academy of Forensic Sciences, San Antonio, TX, February 20, 7 hours.
- 2008 Jantz, R.L., and S.D. Ousley (co-chairs)  
The Uses and Abuses of Statistics and FORDISC in Forensic Anthropology. Workshop given at the 60th Annual Meeting of the American Academy of Forensic Sciences, Washinton, DC, February 19, 8 hours.

## References

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