ANSI/ASB Best Practice Recommendation 010, First Edition 2018

Forensic Anthropology in Disaster Victim Identification: Best Practice Recommendations for the Medicolegal Authority

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ASB Approved March 2018

ANSI Approved October 2018

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Foreword

In a disaster victim identification (DVI) operation, the forensic anthropologist will employ the most appropriate forensic anthropological techniques in a reliable, objective, and timely manner in order to efficiently recover, describe, analyze, and interpret human biological tissues. These efforts will aid in an effective and efficient recovery effort, informative inventory of skeletal tissue represented, and documentation of skeletal features that may lead to positive identification. DVI operations are most effective when using a multi-disciplinary approach that includes principles, methods, and techniques from the field of forensic anthropology. Forensic anthropologists often perform a number of roles in the DVI process. These roles include the initial recovery of and sorting of human from non-biological and non-human remains; inventories of skeletal and anatomical structures present; estimation of chronological age at death, sex, ancestry, and stature; the recognition of skeletal features that may facilitate identification; and preliminary interpretations of skeletal trauma patterns and timing. This information can often be obtained regardless of state of preservation (e.g., complete, fragmented, commingled, or taphonomically-modified). Further, most of these determinations can be made effectively and efficiently by simple gross examination and/or using high-quality radiographs.

This standard was revised, prepared and finalized as a standard by the Disaster Victim Identification Consensus Body of the AAFS ASB. The initial draft document was developed by the DVI Subcommittee of the Organization of Scientific Area Committees. All hyperlinks and web addresses shown in this document are current as the publication date of this standard

Keywords: *Forensic Anthropology, DVI, Best Practices, Morgue Operations, Medicolegal Authority*

Abstract: This document presents best practices recommendations covering the role of forensic anthropologist in the recovery of and identification of human remains. General topics highlighted include activities conducted at the Triage and Anthropology Stations as part of the overall process of human remains examination and identification. Specific focus includes the estimation of the biological profile from human remains.

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1 Scope

The descriptions herein provide guidelines and best practices relevant to the role of forensic anthropology in a DVI operation. Anthropological methods, techniques and principles are typically employed in five primary capacities: 1) during the *Preparedness* phase of a DVI operation, 2) the *Search and Recovery* and preservation of remains from a mass fatality incident, 3) at the *Triage Station* during the initial sorting of material gathered from the field and determination of what human tissue enters the morgue, 4) at the *Anthropology Station* collecting quality postmortem data from each morgue sample, and 5) as a member of the *ID Reconciliation Team*, focused on ensuring valid and reliable positive identifications from human tissues. Focus in this document will be primarily on the *Triage Station* and the *Anthropology Station*. In the absence of specific guidelines, the principle, spirit, and intent of these guidelines should be met.

2 Normative References

There are no normative reference documents, Annex B, Bibliography, contains informative references.

3 Terms and Definitions

For purposes of this document, the following definitions apply.

3.1
forensic anthropology
Forensic anthropology is the application of anthropological methods and theory—particularly those relating to the recovery and analysis of human remains—to resolve legal matters.

3.2
forensic anthropologist
A forensic anthropologist is an individual with at least a masters degree in forensic anthropology, biological anthropology, or related field, and who also has forensic anthropology case experience or training involving fragmentary, burned, and otherwise taphonomically-altered human skeletal remains. They also must have training or experience in producing a biological profile (age, sex, stature, ancestry), and interpreting human skeletal trauma.

NOTE Board-certified forensic anthropologists possess a Ph.D. in forensic anthropology/biological anthropology or related field and are certified by the American Board of Forensic Anthropology (ABFA).

4 Recommendations for the Role of the Forensic Anthropologist

4.1 Preparedness

Preparing for mass fatality responses is typically the responsibility of mass fatality management systems specific to a geographic or jurisdictional area. Forensic anthropologists should be cognizant of, and contribute to, the planning, implementation and management of the entire response process in order to effectively integrate an appropriate forensic anthropology response with other DVI professionals and facilitate timely and accurate identifications.

4.2 Search and Recovery

Most forensic anthropologists have a broad skill set and training in archaeological methodologies. It is highly recommended to include an anthropologist during the entire recovery process to not only maximize recovery/preservation of human remains but to also maintain the integrity of the provenience/context, which may speed the identification process and reduce cost. Constant communication between the field and the laboratory/morgue is essential to fully exploit the efforts performed by both functions.

4.3 Triage

4.3.1 General

Initial sorting of tissues and other evidence gathered in the field occurs at the triage station. It is here that material collected during the search and recovery operation is examined and sorted prior to entering the disaster morgue. Recovered material potentially includes: commingled human tissues; personal effects; vehicle or other structural components; animal and plant matter; and other unsorted items. The goal of the triage station is to segregate all tissue and eliminate commingling of individuals' remains in order not to miss a potential identification. This is achieved by separating out all human tissue not attached via a tissue bridge and attempting to segregate all human tissue from non-human tissue, unassociated personal effects, and any other non-biological evidence.

Immediately following triage activities, all human tissue that will enter the morgue must be assigned a unique morgue reference (or specimen) number. This most often occurs at the adjacent admitting station, or in some situations may be part of the duties of the triage station. Personal effects still directly associated with the human tissue will also enter the morgue via triage, to be separated later in the pathology station or the personal effects station. In most systems, all other dissociated material and debris is documented, removed, placed in the custody of law enforcement, or discarded, but does not enter the disaster morgue. In some post-recovery systems all human and non-human tissue are processed through the disaster morgue, to ensure accountability and analyses of all specimens and to facilitate radiographic examination.

4.3.2 Location of Triage Station in Disaster Morgue Configuration

The triage station should be located at the entrance of the disaster morgue. After the biological tissue evidence (including that which is directly associated with non-biological materials, such as personal effects) is properly recovered and documented in the field (see 4.2, Search and Recovery), the evidence is taken first to the Triage Station.

4.3.3 Triage Station Personnel

The triage station should be staffed by a multidisciplinary team composed of forensic anthropologists, forensic pathologists, and in some cases, law enforcement officials. It is critical that the team includes individuals who:

— can distinguish human from non-biological materials (including those that may mimic the appearance of human remains);

— can distinguish human from non-human tissues, particularly skeletal (osseous and dental) tissues;

— have familiarity with chain of custody principles;

— are experienced with fragmented bone and soft tissue; and

— have experience with heat-altered (i.e., burned) or otherwise compromised remains.

Trained and experienced forensic anthropologists are considered ideal candidates to be members of the triage team. Triage station personnel should be familiar with the DNA analytical protocols that will be used in the DVI process. Law enforcement officials should be assigned to the station, or have their own evidence station associated with the triage station, in order to take possession of unassociated personal effects. Consideration of the specific incident may also indicate which other experts (e.g., an explosives expert) may be necessary to assess evidence.

4.3.4 Triage Station Activities

Triage Station activities should include the physical examination and documentation of all items of interest recovered by field teams. Material wil be systematically sorted into appropriate categories as determined by the operation; human, non-human tissues, associated and not associated personal items, and other non biological items. These activities will ensure that the initial examination of all materials is performed in a coordinated manner in order to preserve the chain of custody and minimize contamination.

— Photography of all specimens should occur as they enter the triage process for accountability and evidentiary purposes.

— All material from each field specimen container should be taken out of the containers and sorted at the triage tables.

— In most circumstances, commingled human tissue should be separated into discrete units.

— As appropriate, specimens from the same field revery container may be associated with each other via fracture-matching or bone conjoining efforts. While this re-association need not generate an identification, it potentially reduces the number of specimens that need to be sampled for DNA analyses and simplifies the identification process.

— Personal effects directly associated with the human tissue, including jewelry, clothing, and objects in clothing pockets should not be disassociated from the human tissue at the triage station. This occurs at the pathology station or at the personal effects station.

— Personal effects not directly associated with human tissue should be separated and should not enter the morgue. Typically, this material should be taken into custody by law enforcement.

— Any biological tissue of non-human animals that may be associated with the mass fatality incident and potentially considered as a pet should be separated and sent to the anthropology station for analysis and confirmation of non-human animal remains.

— Evidence not significant to DVI operations, such as vehicle components, should be separated and should not enter the morgue. Typically, this material should be taken into custody by law enforcement or other investigative agencies.

— Non-significant evidence in the form of non-human animal (non-pet) and plant remains associated with biological tissues should be discarded, while accounting for the field specimen number, if necessary.

After sorting at the triage station, the materials to be processed through the disaster morgue should be placed into clean individual containers/bags, still associated with the field specimen number. A unique morgue number should next be assigned. This can occur in some set-ups at the next (adjacent) morgue station, the admitting station, or it may occur within the triage station in other set-ups.

4.4 Anthropology Station

4.4.1 General

The primary role of the anthropology station is to provide a rapid and succinct inventory of the human tissue, an assessment of the biological profile, and the notation of features that may be useful for identification. In special cases, a detailed assessment of taphonomic issues, including those related to the timing of trauma, may be undertaken. The assessments should be conducted in a timely manner in order to avoid a bottleneck in the morgue flow.

The forensic anthropological analysis conducted in the disaster morgue at the anthropology station should be based on professionally accepted methods and peer-reviewed techniques used in day-to-day forensic anthropology work[1]. However, the scope and scale of biological anthropology analyses conducted should be consistent with the objectives and constraints associated with the DVI process. Due to time and logistical constraints in most DVI scenarios, analyses at the anthropology station are typically more limited. Assessments should be made in a timely manner and according to accepted discipline standards. Anthropologists employed in the disaster morgue should recognize these constraints and work within the framework established by the management of a particular response.

4.4.2 Location of the Anthropology Station in the Disaster Morgue Configuration

Disaster morgue specimens should enter the anthropology station only after documentation by photographic and radiologic, or CT has been completed. It is particularly important that quality radiographs or CT images of the tissues be available at the anthropology station, as many of the anthropological analyses and interpretations can be based on radiographic analysis.

The anthropology station is typically located in the vicinity of the pathology station in order to facilitate discussion of tissues if necessary. In most cases, human tissue enters the pathology location for documentation and analysis before entering the anthropology station, especially when the remains are: a) more complete; b) if personal effects are associated with the tissue, or c) if some modification of the soft tissue (such as those involved in a medicolegal autopsy), is required.

[1] An example of such professionally accepted methods and peer-reviewed techniques is described in Christensen, Angi, Nicholas Passalacqua and Eric Bartelink, *Forensic Anthropology Current Methods and Practice, First Edition*, Academic Press, 2015. See Annex B for additional examples.

If the remains are more fragmentary, there may be more flexibility in the order in which the remains are processed in the pathology unit and anthropology stations.

4.4.3 Anthropology Station Personnel

The primary personnel at the anthropology station include trained forensic anthropologists who have experience dealing with fragmentary, commingled and taphonomically-altered remains, especially, heat and fire-altered bones, and scribes who preferably have a physical anthropology or forensic anthropology background and are familiar with forensic anthropology terminology.

4.4.4 Anthropology Station Activities

4.4.4.1 General

The primary goal of the anthropology station is to collect postmortem data from the bone tissue present in each morgue specimen. These data include; an inventory of bone presen; assessment of biological profile; and, notation of skeletal features that may provide positive identification. Inventories and assessments should be accomplished in an efficient and timely manner. In most cases, analysis of a high-quality, anatomically-oriented, postmortem radiographic image associated with the specimen provides significant and informative data required for these assessments. In most cases, there need not be removal of soft tissue. However, there may be circumstances, for example when a prosthetic device is imbedded in bone, in which some removal of soft tissue is warranted.

It is recommended that a standardized data collection form, preferably in digital format, be used for the collection of the postmortem data.[2]

The first step of the examination is to determine that only one discrete human tissue specimen is present. If human remains are commingled and additional discrete human tissue samples are present, they should be sent back to the Triage Station for a new unique disaster morgue number and go back to the beginning of the morgue documentation process.

4.4.4.2 Descriptions of the Human Tissue

Accurate descriptions of human tissues facilitate the integrity of the DVI process. The description of human tissue should be clear and concise - using appropriate anatomical terminology.

— Description of the human tissue include the bone(s) present, portion of bone represented, side, and other features that may be useful for identification.

— A review of the radiograph associated with the specimen is generally all that is required. However, consistency between the radiograph and the specimen should be verified. Manual palpation may assist in determinations. Cleaning of tissue is generally not necessary, and should be minimal, for example, when using a toothbrush to clean an area.

[2] An example of such professionally accepted methods and peer-reviewed techniques is described in Buikstra, Jane and Douglas Ubelaker, *Standards for data collection from human skeletal remains*. Fayetteville: Arkansas Archeological Survey Research Series No. 44, 1994. See Annex B for additional examples.

— Only a brief description of the bone portion (e.g., distal ¼ of right humerus) is typically necessary.

— Notation is made on standardized data collection forms of skeletal features identified on the postmortem radiographs that may be useful for identification. An initial tentative categorization of the feature (e.g., healed trauma, pathology, or specific skeletal feature) should also be provided.

4.4.4.3 Estimation of Age-at-Death

Estimation of age-at-death should be based on professionally accepted methods and peer-reviewed techniques used in day-to-day forensic anthropology work [3] . Assignment to general age categories provides the most effective and efficient means to provide estimates of chronological age at death in material that is highly fragmented: e.g., juveniles (less than 10 years, 10 to 20 years) and adults (young, middle, and older adult). If the remains are more complete, a more refined estimate may be inferred, especially in juveniles.

— In more complete remains, multiple areas of the skeleton should be assessed.

— Analysis of the radiograph associated with the human tissue provides most of the information necessary for estimations of age at death. Radiographic analysis typically focuses on dental development, epiphyseal fusion patterns, location and extent of vertebral body lipping, evidence of joint lipping, chest plate ossification patterns, and other established aging methodologies that can be assessed radiographically.

— The soft tissue from the bones need not be removed in most cases, (e.g., to study the pubic symphysis or the auricular surface of the ilium) since the probative value contributing to a positive identification will likely be minimal.

4.4.4.4 Assessment of Sex

Sex assessment should be based on professionally accepted methods and peer-reviewed techniques used in day-to-day forensic anthropology work[4]. Sex assessment can be performed from the analysis of the postmortem radiograph associated with the morgue specimen. In some cases, limited soft tissue can be removed to take measurements.

— In more complete remains, multiple areas of the skeleton can be assessed.

— Focus will be on general size and robusticity of the specimen.

— Some secondary sexual characteristics (e.g., greater sciatic notch) can be used to assess sex.

[3] An example of such professionally accepted methods and peer-reviewed techniques is described in Natalie R. Langley and MariaTeresa A. Tersigni-Tarrant, Forensic Anthropology: A Comprehensive Introduction, Second Edition, CRC Press, 2017. See Annex B for additional examples.

[4] An example of such professionally accepted methods and peer-reviewed techniques is described in Christensen, Angi, Nicholas Passalacqua and Eric Bartelink*, Forensic Anthropology Current Methods and Practice, First Edition*, Academic Press, 2015. See Annex B for additional examples.

— A few standard measurements (e.g., femoral head diameter) may be obtained after limited soft tissue removal or even taken from radiographic images and entered into standard formulae or into computer software programs, such as Fordisc[5] if appropriate.

4.4.4.5 Assessment of Ancestry

Assessment of ancestry should be based on professionally accepted methods and peer-reviewed techniques used in day-to-day forensic anthropology work [6]In more complete remains, or those not altered by heat or trauma, estimates of ancestry may be provided.

— Assessment of ancestry can be attempted on more complete crania that include the facial skeleton.

— Well-accepted or validated methods for analyzing non-metric features may be used to assess ancestry.

— Measurements relevant to assessing ancestry may also be taken and utilized with a computer software program such as Fordisc[5] if deemed necessary.

4.4.4.6 Estimation of Stature

Estimation of living stature should be based on professionally accepted methods and peer-reviewed techniques used in day-to-day forensic anthropology work[7]. Stature estimates are often limited or not possible in DVI contexts, especially in cases where remains are fragmented and sex and ancestry of the individual is not known. For more complete skeletal remains, or those not altered by decomposition or heat-alteration, estimates of stature may be generated.

Measurements from long bones, including incomplete long bones, can be utilized with a computer software program such as Fordisc[5], although it is not recommended to completely excise long bones from soft tissue in order to obtain measurements. In some cases, osteometric measurements may be derived from digital imaging. Measurements should be adjusted to dry bone values when estimated from imaging sources.

4.4.4.7 Features that May Facilitate Identification

In some cases, skeletal features, such as healing or healed antemortem fractures, or rare characteristics of the bones, noted on postmortem radiographs, may be used to suggest identifications, if the proper antemortem record is available.

In those cases in which an artificial appliance or prosthetic device is associated with the human tissue specimen, identifications can sometimes be made via comparison of antemortem and

[5] This application is used as an example only, and does not constitute an endorsement of this product by the AAFS Standards Board. FORDISC is an interactive computer program that runs under Windows for classifying adults by ancestry and sex using any combination of standard measurements.
[6] An example of such professionally accepted methods and peer-reviewed techniques is described in Natalie R. Langley and MariaTeresa A. Tersigni-Tarrant, Forensic Anthropology: A Comprehensive Introduction, Second Edition, CRC Press, 2017. See Annex B for additional examples.
[7] An example of such professionally accepted methods and peer-reviewed techniques is described in Natalie R. Langley and MariaTeresa A. Tersigni-Tarrant, Forensic Anthropology: A Comprehensive Introduction, Second Edition, CRC Press, 2017. See Annex B for additional examples.

postmortem radiographs or investigation of manufacturer markings (including insignia, lot numbers, and serial numbers). The tissue should be removed or modified in order to look for manufacturer markings after the remains have been processed by the Pathology Station.

4.5 Reconciliation

Forensic anthropologists provide an important role in the final reconciliation of human remains, and should be included in all aspects of reconciliation committee functions. Anthropologists offer a thorough understanding of human anatomy and human osteological variants that can be used to reconcile postmortem and antemortem records that include photographs, CT or other radiographic media.

Annex A
(informative)

Foundational Principles

Disaster victim identification (DVI) refers to the component of fatality management of a mass fatality incident that involves the scientific identification of human remains.

Professionally accepted anthropology methods and peer-reviewed techniques as used in day-to-day forensic anthropology work are also applied to DVI anthropology operations. In addition to the specific requirements of non-DVI anthropology work, DVI anthropological work requires coordination with the entire DVI team, as reflected in the content of this document.

Annex B
(informative)

Bibliography

Examples of professionally accepted procedures are available in the following resources. This is not to be construed as an exhaustive or complete list.

1] Forensic Anthropology: A Comprehensive Introduction. Langley NR and Tersigni-Tarrant MT, CRC Press 2nd Edition. 2017.

2] Forensic Anthropology Current Methods and Practice, (1st ed.). Christensen A., Passalacqua N, and E. Bartelink. Academic Press, 2015.

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