

Forensic Anthropological Examinations

1 Scope

This document describes general guidelines for forensic anthropological examinations by Anthropology Examiners within the Trace Evidence Unit (TEU). This document also outlines general evidence handling and documentation procedures, and types of information that can be obtained from anthropological examinations. Procedures for specific types of forensic anthropological examinations are contained in separate documents.

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within ± 0.5 mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX or equivalent)
- Spreading calipers capable of measuring items up to 300mm within ± 0.5 mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10 or equivalent)
- Osteometric board (Paleo-Tech Field Osteometric Board, or equivalent)
- Mandibulometer (Paleo-Tech Mandibulometer or equivalent)
- 3-dimensional digitizer (MicroScribe G2 LX or equivalent)
- Tape measure
- Personal protective equipment (lab coat, gloves, eye protection or better, as needed)
- Stereobinocular microscope, magnification range from 0.5x to at least 40x
- Sectioning/wafering saw (Isomet Precision Saw or equivalent)
- Microscope for Histology with associated measuring devices
- X-Ray Fluorescence Spectrometer (EDAX Eagle III XXL micro x-ray fluorescence spectrometer, or equivalent)
- Digital camera (Nikon D70, or equivalent)
- Digital radiography unit (NorthStar X-5000 X-radiography unit, Kubtec radiography unit or equivalent)
- FORDISC 3.0 or more recent version
- Reversible adhesive (Paraloid B-72 or equivalent)
- Permanent adhesive (cyanoacrylate or equivalent)
- Water bath
- Nylon brush (e.g., toothbrush)
- Human skeletal reference casts
- Probe, scalpel, forceps
- Hot plate (capable of bringing water almost to the boiling point)
- Sandbox (capable of accommodating and stabilizing human bones and fragments)

- Sand
- Wooden struts
- Detergent (Tergazyme or equivalent)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

5.1 Processing Skeletal Material

5.1.1 The examiner will conduct an inventory of the skeletal remains or material present. Depending on the material(s) present and number of items and/or number of individuals present, this inventory may be recorded on a Dental Chart (Appendices A, B) and/or Skeletal Inventory Form (Appendix D), as appropriate. Each item or its primary packaging will be labeled in accordance with the FBI Laboratory Operations Manual – Practices of Processing a Submission and Evidence Breakdown.

5.1.2 Photographs, with a scale included, will be taken prior to any examination or processing that may alter the evidence. Photographs may also be taken to record important features or evidence at the discretion of the examiner.

5.1.3 Any soft tissue or other substances or debris adhering to the remains that obstructs the analysis may be removed. This typically involves processing the remains by maceration (which may include the application of heat at the discretion of the examiner) and gently scrubbing the material with a nylon brush. In some cases, (e.g., when there is significant soft tissue and/or the material is greasy), detergent may be added to the water to facilitate maceration. Additional processing tools such as probes, scalpels and forceps may also be used to remove connective tissue or strongly adhering debris. If such tools are used, care should be taken to avoid damaging bones, and any incidental alterations will be recorded in the case notes. Any associated debris that may require further examination (e.g., hairs, soil) will be recorded, removed, and packaged appropriately for further analysis by appropriate personnel.

5.1.4 Fragmented bones will be reassembled to the extent possible when appropriate. In cases where reassembly will be facilitated by affixing fragments (such as extreme fragmentation or a large number of specimens), reversible adhesives and stabilizing equipment such as sand and struts may be used.

5.2 Anthropological Examinations

The following anthropological examinations may be performed depending on the nature of the request and/or the condition of the material present. Procedures for these examinations and how to reach possible conclusions are contained in standard operating procedures (SOPs) specific to each:

- Determining Skeletal or Non-skeletal Origin
- Determining Human or Non-Human Origin
- Bone Histomorphology
- Estimation of Biological Profile
- Resolving Commingled Skeletal Remains
- Personal Identification
- Trauma Analysis
- Facial Approximation
- Medicolegal Significance
- Taphonomy
- Operational Response and Field Assessments

Identification comparisons involving the comparison of questioned (postmortem) and known (antemortem) skeletal information (i.e., those falling under the comparison section of the Personal Identification SOP) require verification. The verification procedure is contained within that SOP.

The techniques used for these analyses may include visual examination, metric analysis, microscopic examination, radiologic examination, or elemental analysis.

5.2.1 Macroscopic (Visual) Examination

An anthropological analysis will include a macroscopic (or visual) examination of skeletal material using sufficient lighting. In some cases, only a macroscopic examination may be necessary. The general condition of skeletal remains and relevant features will be recorded in the case notes.

5.2.2 Metric Analysis

Where applicable, relevant and available skeletal measurements will be taken according to relevant published guidelines using calipers, osteometric board, tape measure, and mandibulometer and may be recorded on the Forensic Skeletal Measurements Form (Appendix C). Measurements may also be collected using a 3D digitizer. Where applicable and with the consent of the contributor, these data will be submitted to the Forensic Data Bank. Additional measurements, such as those documenting trauma, will be taken and included in the case notes. Calipers, mandibulometers, osteometric boards used in the procedure are serviced and calibrated annually by an external vendor.

5.2.3 Microscopic Examination

When greater magnification is required for adequate analysis, the material will be examined using a stereobinocular microscope. If necessary, this may involve preparing thin sections of the material using a wafering saw. For preparing thin sections, refer to the Bone Histomorphology Procedure. Any relevant information such as settings or specific techniques used will be recorded in the case notes.

5.2.4 Radiologic Examination

When radiologic examination of the material is necessary, (e.g., to reveal the internal structure of skeletal material or look for the presence of foreign material) digital radiography will be used. For taking radiographs, examiners will refer to and follow the Chemistry Unit, Metallurgy, Digital Radiography procedure or other appropriate instrument-specific procedures. Any relevant information such as settings or specific techniques used will be recorded in the case notes.

5.2.5 Elemental Analysis

If the determination of elemental composition of the material is required to ascertain whether the submitted evidence/material is osseous (bone) or dental (tooth) in origin (versus some other non-osseous or non-dental material), the material will be examined using X-Ray Fluorescence Spectrometry (XRF). For XRF analysis, refer to and follow the appropriate Chemistry Unit, Metallurgy procedure(s) regarding x-ray fluorescence spectrometry. Any relevant information such as settings or specific techniques used will be recorded in the case notes.

5.3 Examination of Images

The examination of images (including photographs and digital images) is typically for the purpose of providing timely lead information regarding whether material is skeletal or non-skeletal in origin, or whether it is human or non-human in origin. Examination of other types of images (such as those from autopsy reports) may be performed on a limited, case-by-case basis. The conclusions that can be reached based on the examination of images are dependent on the condition and completeness of the skeletal material as well as the quality of the images. Results may be limited or inconclusive. If inconclusive, the examiners may recommend that the material be submitted to the FBI Laboratory for direct analysis.

5.4 Odontological Examinations

In cases where an odontological examination is requested and/or deemed appropriate by the examiners, the odontological examination may be performed by a competent subcontractor according to the FBI Laboratory Quality Assurance Manual.

5.5 Reporting

Results will be reported in an FBI *Laboratory Report* (7-1, 7-1 LIMS) according to the procedures detailed in the SOPs for the specific examinations (e.g., Estimation of Biological Profile, Trauma Analysis) and the Trace Evidence General Approach to Report Writing. Where applicable, a description of the analytical method(s) used and associated limitations will be included in the report. Examples of limitation wording may be found in the “Limitations” sections of the specific examination SOPs.

Any information that is outside the scope of procedures detailed in the SOPs for the specific examinations that may aid in an identification or investigation (e.g., suggestions for database entry) may be included in the report under a section entitled “Remarks.”

In the event that human skeletal remains are determined to be not of medico-legal significance (e.g., archaeological contexts, disturbed cemeteries, anatomical collections, ceremonial remains, trophy skulls), this will be indicated in the report. In addition, where appropriate, contributors will be advised that the dispensation of the submitted items may be subject to state and federal regulations (e.g., Native American Graves Protection and Repatriation Act).

Externally provided odontological examinations will be included as an attachment to the anthropological report or as an attachment to a supplemental anthropological report, as appropriate.

5.6 Evidence Return

Upon completion of anthropological examinations, the evidence will be returned to Evidence Management Unit personnel for a multiple unit submission or mailed to the contributor for a single unit submission.

6 Calculations

Calculations carried out as part of a biological profile will be performed according to appropriate reference data. Refer to the Estimation of Biological Profile Procedure.

Calculations may be carried out manually or through the use of software including FORDISC. The source(s) of the formula(e) and calculations used will be recorded in the case notes

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the caliper used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.3 The measurement uncertainty with the MicroScribe digitizer is less than 0.3 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological examinations are dependent on the condition and completeness of the remains, and the availability and quality of antemortem data. Limitations specific to particular examination may be found in the associated SOPs.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, x-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- FBI Laboratory Quality Assurance Manual (current version)
- Trace Evidence General Approach to Report Writing, Trace Evidence Quality Manual (current version)
- Digital Radiography Procedure, Chemistry Unit, Metallurgy (current version)
- Operation of the Thermo QUANT'X X-Ray Fluorescence Spectrometer Procedure, Chemistry Unit, Metallurgy (current version)
- Operation of the Olympus Delta Premium Handheld X-Ray Fluorescence Spectrometer, Chemistry Unit, Metallurgy (current version)
- FBI Laboratory Operations Manual (current version)

- Determining Skeletal or Non-skeletal Origin, Trace Evidence Procedures Manual (current version)
- Bone Histomorphology, Trace Evidence Procedures Manual (current version)
- Determining Human or Non-Human Origin, Trace Evidence Procedures Manual (current version)
- Estimation of Biological Profile, Trace Evidence Procedures Manual (current version)
- Resolving Commingled Skeletal Remains, Trace Evidence Procedures Manual (current version)
- Personal Identification, Trace Evidence Procedures Manual (current version)
- Trauma Analysis, Trace Evidence Procedures Manual (current version)
- Facial Approximation, Trace Evidence Procedures Manual (current version)
- Operational Response and Field Assessments, Trace Evidence Procedures Manual (current version)
- Assessment of Taphonomic Alterations, Trace Evidence Procedures Manual (current version)
- Assessment of Medicolegal Significance of Human Skeletal Remains, Trace Evidence Procedures Manual (current version)
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
2	02/07/18	<p>Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1.</p> <p>Updated Section 2.</p> <p>Removed Section 4 Calibration and renumbered document.</p> <p>Added 'Sample Selection' to new Section 4.</p> <p>Updated language in Section 5.1 and subsections for clarity including that the forms are optional for recording information.</p> <p>Updated anthropological examinations in Section 5.2.</p> <p>Updated Section 5.2.2 regarding published guidelines, a 3D digitizer, service and calibration of equipment used in examinations, and that form is optional for recording information.</p> <p>Updated Sections 5.2.3 through 5.2.5 for clarity and for documents referenced.</p> <p>Updated Section 5.3 for clarity regarding when/why these examinations are typically completed.</p> <p>Clarified requirements for competent subcontractor for Section 5.4.</p> <p>Added Trace Evidence General Approach to Report Writing to Section 5.5 and added <i>Laboratory Reports</i>.</p> <p>Removed former Section 5.6 on verification as covered in specific SOPs as appropriate and renumbered remaining section.</p> <p>Updated new Section 5.6 for clarity on evidence returns.</p> <p>Updated Sections 6 and 7 including adding Section 7.3.</p> <p>Updated references in Section 10.</p>
3	12/16/19	<p>Updated Scope.</p> <p>Changed forensic anthropologist to Anthropology Examiner in Scope and to examiner throughout document.</p> <p>Updated Section 5.2 to include what examinations require verification.</p>

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief

Date: 12/13/2019

Anthropology Technical
 Leader

Date: 12/13/2019

Appendix A: *Anthropology Adult Dental Chart*

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Appendix B: *Anthropology Deciduous Dental Chart*

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Appendix C: *Anthropology Forensic Skeletal Measurements Form*

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Appendix D: *Anthropology Skeletal Inventory Form*

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Bone Histomorphology

1 Scope

Bone histomorphology can assist in determining whether human origin of osseous material can be excluded on the basis of bone microstructure. This document describes how to embed, section, grind, polish, mount, and examine specimens for histomorphological analysis performed by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Bone saw (Dremel tool or equivalent)
- Sonic cleaner
- Sonic cleaning solution (Ultramet or equivalent)
- Degreaser (Clear-Rite or equivalent, xylene, or acetone)
- Embedding molds (Peel-Away or equivalent)
- Balance
- Resin mixing container (e.g., paper cup)
- Embedding resin (EpoThin resin or equivalent)
- Embedding resin hardener (EpoThin hardener or equivalent)
- Stirring stick (e.g., tongue depressor or wooden rod)
- Vacuum pump
- Sectioning/wafering saw (Isomet Precision Saw or equivalent)
- Cutting fluid (Ultramet or equivalent)
- Cutting blade (high concentration diamond-edged blade or equivalent)
- Blade dressing stick
- Grinder/polisher (Ecomet Grinder/Polisher or equivalent)
- Grinding/polishing discs and cloths in a variety of abrasive grit levels
- Mounting medium or resin (Permount, Crystalbond or equivalent)
- Forceps/tweezers
- Glass microscope slides
- Cover slips
- Transmitted light microscope with 10x and 20x objectives
- Bone histomorphological image exemplars
- Personal protective equipment (e.g., lab coat, gloves, eye protection)

3 Standards and Controls

Not applicable.

4 Sampling

4.1.1 If multiple bone fragments are present, sample selection is dependent upon whether the bone has identifiable cortical bone that could potentially yield a thin section, and whether the fragment needs to be embedded using resin. If DNA analysis may also be performed, consultation with a DNA examiner is recommended prior to finalizing sample selection.

4.1.2 Histomorphological analysis requires a true transverse section, and therefore the determination of anatomical orientation of the specimen is required. In specimens where this orientation cannot be determined, results will be accompanied by an appropriate caveat.

4.1.3 For cases involving a single fragment, a small specimen for histomorphological analysis will be used, leaving some of the original fragment, if possible. The specimen will be cut using a bone saw. If the original fragment is too small, the entire item will be embedded.

5 Procedures

The Forensic Anthropological Examinations procedure will be followed. In cases where the examination requires the determination of whether skeletal material is human or non-human in origin, the following procedures may be used. Depending on the quantity and quality of the material submitted and the nature of the examination request, each of the below steps may not be required. Observations supporting conclusions will be recorded in the case notes.

5.1 Embedding

5.1.1 Embedding is used to stabilize fragments when the specimen is of a small size and/or is taphonomically compromised. Embedding may not be necessary in cases where bone fragments are of sufficient size and quality to be held in the cutting chuck, in which case the examiner may proceed to sectioning.

5.1.2 Prior to embedding, sonic cleaning (with optional 1:20 parts cleaning solution) may be performed at the discretion of the examiner to remove debris. If a sonic bath is used, the specimen will be allowed to dry for 24 hours prior to embedding.

5.1.3 If the skeletal material is fresh/greasy, it may be degreased by placing the sample in a degreaser to remove lipids which will diminish slide quality.

5.1.4 The appropriate embedding mold will be selected such that the specimen will fit within the mold without touching the sides or bottom of the mold. To facilitate this, a thin layer of embedding medium may be poured into the mold and allowed to cure for approximately 24 hours, providing a platform for the sample to ensure that the specimen does not touch the bottom of the mold.

5.1.5 Using a balance, graduated container, or other liquid measuring device, and a mixing container such as a disposable paper cup, an appropriate amount of resin (depending on the mold size and sample size) will be measured and hardener will be added according to the manufacturer's instructions. The mixture will be stirred using a stirring stick for approximately

2 minutes until the mixture is clear or according to manufacturer's instructions.

5.1.6 The mold and specimen will be labeled with the Laboratory Number and item identifier. This may be achieved using a pencil on paper embedded within the resin with the specimen. The resin/hardener mixture will be poured into the mold(s), allowing a thorough covering of the specimen with epoxy but not overfilling the mold.

5.1.7 The specimen will be oriented/aligned within the resin using forceps or a probe if necessary, and the label will be arranged so that it is secure and visible. If large air bubbles are present within the epoxy, they may be removed by placing the mold(s) into a vacuum pump.

5.1.8 The epoxy will be allowed to cure for approximately 24 hours, and the plastic molds will then be removed and discarded. Sharp edges on the top of the epoxy block may be removed using sand paper.

5.2 Thin Sectioning

5.2.1 Thin sections will be made using a wafering saw. The saw will be prepared by filling the reservoir with water and, at the discretion of the examiner, approximately 1:20 parts of cutting fluid. The blade will be mounted and tightly secured on the blade stand. The blade will be dressed as needed using the blade dressing stick.

5.2.2 The bone or epoxy block will be mounted in the chuck and attached to the saw's specimen arm. Specimens will be mounted in a manner that produces an anatomically transverse section (as best as possible, when orientation is known).

5.2.3 The counterweights will be adjusted as necessary to counter balance the weight of the arm, chuck, and sample. A flushing/waste cut will be made by lowering the specimen to the blade, and the measurement point will then be zeroed.

5.2.4 The specimen arm will be positioned to make a section that is 0.8mm (preferable if possible) to 1.5mm thick (if necessary in cases of more friable specimens), at a blade speed of approximately 100rpm. Additional sections will be made as necessary until the desired number of sections have been removed. Three sections are recommended in most cases.

5.2.5 The thin section will be removed from the saw, using forceps if necessary. If the section will be mounted without grinding or polishing, it will be allowed to dry prior to mounting.

5.3 Grinding and Polishing

5.3.1 Grinding and polishing will be performed using a grinder/polisher and removable grinding and polishing discs/platens. Grinding reduces the specimen to a thickness appropriate for analysis, and polishing removes striations on the specimen from the cutting and grinding processes.

5.3.2 Polishing and grinding is best performed immediately after thin sectioning in order to avoid the introduction of water on the specimen multiple times.

5.3.3 Grinding and polishing discs and cloths will be affixed to the rotating platen by magnet or adhesive. Grinding platens will be dressed as needed.

5.3.4 The specimen may be held, applying even pressure, using a manufactured specimen holder, or by holding the specimen to the disc with the aid of a hand-made gripping device (e.g., a microscope slide covered in sandpaper or tape to hold the specimen in place).

5.3.5 Grinding will use successively finer abrasive as needed, until the specimen is reduced to a thickness that allows sufficient transmission of light through the specimen (typically 50-75 micrometers). Water may be added during the grinding process. Thickness and suitability for examination can be periodically tested using microscopy.

5.3.6 Polishing will use successively finer polishing paper/cloths as needed. Suitability for examination can be periodically tested using microscopy.

5.3.7 Grinding and polishing may be repeated/continued as necessary to achieve a section suitable for histomorphological examination. Following grinding and polishing, a sonic bath may be used at the discretion of the examiner to remove particles.

5.4 Slide Preparation

5.4.1 Prior to mounting, the specimen should be allowed to dry. Weight may need to be applied to the specimen to avoid warping.

5.4.2 The microscope slide will be labeled with the Laboratory Number, item identifier, date, and initials of the preparer.

5.4.3 Mounting medium, as needed, will be applied to the center of the slide.

5.4.4 Using forceps, the specimen will be placed on the slide, and additional mounting medium will be applied as necessary. The specimen will be covered with a cover slip to optimize optics for microstructure resolution, and allowed to dry. Weight may be used to even out the coverslip.

5.4.5 The slide will be allowed to dry for at least one day before reading, and two to four weeks before storing in a slide box.

5.5 Examination and Data Collection

5.5.1 The prepared slides will be examined using a transmitted light microscope with 10x and 20x objectives. The total magnification and filter used, typically 100x, polarized, will be recorded in the case notes.

5.5.2 Specimens will be qualitatively examined for the presence of Haversian bone. Haversian bone is characterized by concentric lamellae surrounding longitudinal canals resulting in a circular osteon in transverse section. The presence of histomorphology consistent with Haversian bone supports the conclusion that human origin cannot be excluded.

5.5.3 The presence of histomorphology consistent with non-Haversian bone (e.g., fibrolamellar, laminar, plexiform bone) supports the conclusion that the bone is non-human in origin (i.e., that human origin can be excluded).

5.5.4 The presence of osteon banding (i.e., multiple areas of linear osteonal organization) supports the conclusion that the bone is non-human in origin (i.e., that human origin can be excluded).

5.5.5 In some cases, histomorphological material can be compared with image exemplars appearing in published literature. Referenced literature or exemplars will be recorded in the case notes.

5.6 Reporting

5.6.1 In the event that the remains are determined to be non-human, this will be stated in the FBI *Laboratory Report* (7-1, 7-1 LIMS). When possible or appropriate, the origin(s) of the remains will also be stated. For example: *“The submitted item(s) is/are skeletal material of non-human origin (or human origin can be excluded). No further anthropological examinations were conducted.”*

5.6.2 In the event that human origin cannot be excluded, this will be stated in the *Laboratory Report*. For example: *“The submitted item(s) cannot be excluded as human in origin.”* Where possible or appropriate, examinations will proceed according to the examination request following appropriate Standard Operating Procedures.

5.6.3 In the event that the examination is inconclusive, the *Laboratory Report* will state this. For example: *“The submitted item(s) is/are of undetermined origin. No further anthropological examinations were conducted.”*

6 Calculations

Not applicable.

7 Measurement Uncertainty

Not applicable.

8 Limitations

8.1 The conclusions that can be reached regarding human or non-human origin are dependent on the condition and completeness of the skeletal remains. Results based on fragmentary or poorly preserved material may be inconclusive.

8.2 Human versus non-human origin of bone cannot always be determined on the basis of

bone microstructure.

9 Safety

9.1 While working with physical evidence, Laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, eye protection, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to physical, biological and chemical hazards may be associated with the examination techniques performed. Safety procedures related to specific materials, instruments or equipment (e.g., wafering saws) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- FBI Laboratory Safety Manual (current version)
- Crowder C, Stout S. Bone Histology: An Anthropological Perspective. CRC Press: Boca Raton, 2012.
- Mulhern DM, Ubelaker DH. Differences in osteon banding between human and nonhuman bone. Journal of Forensic Sciences 2001; 46(2):220-222.

Rev. #	Issue Date	History
2	02/07/2018	<p>Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1 and throughout document.</p> <p>Added 'or Sample Selection' to Section 4 title.</p> <p>Moved former Sections 5.1.1, 5.1.2, and 5.1.3 to Section 4.</p> <p>Updated Sections 5.1.4 and 5.1.8 to specify approximate curing time.</p> <p>Provided materials to use in Section 5.1.5 as well as adding manufacturer's instructions.</p> <p>Added discretion of forensic anthropologist to Section 5.2.1.</p> <p>Section 5.2.4 added three sections are recommended in most cases.</p> <p>Updated Section 5.3.4 to add tape as option.</p> <p>Section 5.3.5 revised to provide guidance of sufficient transmission of light.</p> <p>Removed reference to glossy surface in Section 5.3.6.</p> <p>Added Laboratory Report to Sections 5.6.1, 5.6.2, and 5.6.3.</p> <p>Updated references in Section 10.</p>
3	02/10/2020	<p>'Sample Selection' removed from Section 4 title.</p> <p>Added reference to DNA analysis Section 4.1.1.</p> <p>Updated wording in Sections 5.1.4, 5.1.6, and 5.6.1.</p> <p>Added examples to Sections 5.5.3 and 5.5.4.</p> <p>Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout document.</p>

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief

Date: 02/07/2020

Anthropology Technical
 Leader

Date: 02/07/2020

Determining Human or Non-Human Origin

1 Scope

This document describes guidelines for determining whether skeletal remains originate from a human or non-human (other animal) source by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX, or equivalent)
- Spreading calipers (digital or analog) capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10, or equivalent)
- Personal protective equipment (lab coat, gloves, eye protection or better, as needed)
- Stereobinocular microscope, magnification range from 0.5x to at least 40x
- Osteometric board (Paleo-Tech Field Osteometric Board, or equivalent)
- Tape measure
- Human and non-human skeletal reference casts
- Human and non-human skeletal reference material (e.g., museum collections)
- Sectioning/wafering saw (Isomet Precision Saw, or equivalent)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

The Forensic Anthropological Examinations procedure will be followed. In cases where the examination requires the determination of whether skeletal material is human or non-human in origin, the following techniques may be used. In some cases, one of the following techniques may be sufficient, while others may require the use of multiple techniques to reach a conclusion. Observations supporting conclusions will be recorded in the case notes.

5.1 Procedures for Determining Human or Non-human Origin

5.1.1 The skeletal material will be evaluated by macroscopic visual examination to assess morphology, looking for features or landmarks that are characteristic of human or non-human species. The determination of whether material is human or non-human can usually be achieved by visual examination if the specimens are sufficiently large and in good condition, using the examiner's professional training and knowledge of human and non-human osteology. The presence of features or landmarks consistent with human skeletons supports the conclusion that the material is human in origin. The presence of features or landmarks that are not consistent with human skeletons, or that are consistent with non-human skeletons, supports the conclusion that the material is non-human in origin.

5.1.2 The skeletal material may be evaluated by quantitative assessment to determine whether it is within the known range of size variation of human skeletons. Measurements can be taken with calipers, an osteometric board, or a tape measure. The presence of size characteristics consistent with human skeletons supports the conclusion that material is human in origin. The presence of size characteristics that are not consistent with human skeletons or consistent with non-human skeletons supports the conclusion that the material is non-human in origin.

5.1.3 The skeletal material may be compared to information or data from published literature and/or skeletal exemplars including skeletal reference casts or skeletal reference material. Consistency of the material with human exemplars supports the conclusion that the material is human in origin. Inconsistency of the material with human exemplars or consistency with non-human exemplars supports the conclusion that the material is non-human in origin.

5.1.4 The microscopic structure of the skeletal material may be analyzed following the Bone Histomorphology procedure.

5.2 Reporting and Further Examinations

5.2.1 In the event that the remains are determined to be human, examinations will proceed according to the examination request following appropriate procedures.

5.2.2 In the event that the remains are determined to be non-human, this will be stated in the FBI *Laboratory Report* (7-1, 7-1 LIMS). When possible or appropriate, the origin(s) of the remains will also be stated. For example: "*The submitted item(s) is/are skeletal material of non-human origin. No further anthropological examinations were conducted*"

5.2.3 In the event that the remains are determined to be human and have been submitted only for DNA analysis, this will be stated in the *Laboratory Report*. For example "*The submitted item(s) is/are bones of human origin, and will be submitted to the DNA Casework Unit for analysis*".

5.2.4 In the event that the examination is inconclusive, this will be stated in the *Laboratory Report*. For example "*The submitted item(s) is/are bone/tooth of undetermined origin. No further anthropological examinations were conducted.*"

6 Calculations

Not applicable.

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the calipers used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of measurement uncertainty does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of measurement uncertainty does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached regarding human or non-human origin are dependent on the condition and completeness of the skeletal remains. Result based on fragmentary or poorly preserved material may inconclusive.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Bone Histomorphology, Trace Evidence Procedures Manual (current version)
- FBI Laboratory Safety Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Determination of Medicolegal Significance from Suspected Osseous and

Dental Remains (current version).

Rev. #	Issue Date	History
1	02/07/2018	Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1. Updated Section 2. Removed Section 4 Calibration and renumbered. Added 'or Sample Selection' to new Section 4 title. Updated wording in Sections 5 for clarity. Updated Sections 5.1.1 and 5.1.2 to replace bones with skeleton. Section 5.1.4 updated to reference Bone Histomorphology SOP. In Sections 5.2.2, 5.2.3, and 5.2.4 replaced report with Laboratory Report. In Section 5.2.3 also updated DNA unit. Updated Section 7.
2	02/10/2020	Updated references in Section 10. 'Sample Selection' removed from Section 4 title. Added reference to non-human osteology to Section 5.1.1. Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope

Redacted - Signatures on File

Approval

Trace Evidence Unit
Chief

Date: 02/07/2020

Anthropology Technical
Leader

Date: 02/07/2020

Determining Skeletal or Non-skeletal Origin

1 Scope

As part of forensic anthropological examinations, it is sometimes necessary to determine whether the submitted evidence/material is skeletal including osseous (i.e., bone) or dental (i.e., tooth) in origin versus some other non-osseous or non-dental material. This document describes guidelines for determining whether material is consistent with originating from a bone or tooth by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Stereobinocular microscope, magnification range approximately 2x to approximately 40x
- Sectioning/wafering saw (Isomet Precision Saw or equivalent)
- Digital radiography unit (NorthStar X-5000 X-radiography unit or Kubtek radiography unit, or equivalent)
- X-Ray Fluorescence Spectrometer (EDAX Eagle III XXL Micro X-Ray Fluorescence Spectrometer, or equivalent)
- National Institute of Standards and Technology (NIST) Hydroxyapatite Standard
- Personal protective equipment (e.g., lab coat, gloves, eye protection)

3 Standards and Controls

NIST Standard Reference Material[®] 2910a Calcium Hydroxyapatite

4 Sampling

Sub-samples of the submitted material may be examined at the discretion of the examiner. The individual sub-samples may not be representative of the entire specimen. Sub-samples are chosen based on the need to identify a particular component by a specific technique, and by its availability or presence.

5 Procedures

The Forensic Anthropological Examinations procedures will be followed. The determination of whether material is skeletal or non-skeletal can usually be achieved by visual examination if the specimens are sufficiently large and in good condition. Occasionally, specimens are very small and/or taphonomically compromised, precluding conclusions based on visual examination. In some cases, one of the following techniques may be sufficient, while in other cases, multiple techniques may be required to make a conclusion. Observations supporting conclusions will be recorded in the case notes.

5.1 Procedures for Determining Skeletal Versus Non-Skeletal

5.1.1 The material will be evaluated by macroscopic visual examination to assess the presence or absence of features or structures that characterize osseous and dental material to include overall size and morphology, landmarks, trabeculae, density, color, and reflectivity. The presence of features consistent with osseous or dental material supports the conclusion that the material is skeletal in origin.

5.1.2 The material may be evaluated by microscopic examination using a stereobinocular microscope to assess the presence or absence of features or structures that characterize skeletal material to include overall size and morphology, landmarks, trabeculae, and vascular systems. At the discretion of the examiner, this may involve preparing a thin section using a wafering saw following the Bone Histomorphology procedure. The presence of features consistent with skeletal material supports the conclusion that the material is skeletal in origin.

5.1.3 The material may be evaluated by radiographic examination using digital radiography following the Chemistry Unit, Metallurgy Digital Radiography procedure or other instrument-specific procedures to assess the presence or absence of features or structures that characterize skeletal material to include morphology, landmarks, and trabeculae. The presence of features consistent with osseous or dental material supports the conclusion that the material is skeletal in origin.

5.1.4 The material may be evaluated by X-ray fluorescence using an XRF spectrometer following the Chemistry Unit, Metallurgy procedure for Operation of the EDAX Eagle III XXL Micro X-Ray Fluorescence Spectrometer or other instrument-specific procedures of an equivalent XRF spectrometer to determine the elemental composition. Prior to analyzing the evidence, the NIST Hydroxyapatite Standard will be analyzed, and the results maintained in the case notes. The presence of significant calcium and phosphorus peaks supports the conclusion that the material is skeletal in origin.

5.2 Records

5.2.1 Case Notes

The case notes will include examinations used and all observations of traits and features used to determine skeletal versus non-skeletal origin. Where appropriate, this may include radiological images, photographs, and instrument printouts.

5.2.2 Reports

5.2.2.1 In the event that the material is determined to be skeletal in origin, this will be stated in the FBI *Laboratory Report* (7-1, 7-1 LIMS). For example: “*The material is consistent with skeletal origin*”. Osseous or dental origin may also be specified as appropriate.

5.2.2.2 In the event that the material is determined to be non-skeletal in origin, the report will state this. For example: “*The submitted item(s) is/are non-skeletal in origin. No further anthropological examinations were conducted.*”

5.2.2.3 In the event that the examination is inconclusive, the report will state this. For example: *“The submitted item(s) is/are of undetermined origin. No further anthropological examinations were conducted.”*

6 Calculations

Not applicable.

7 Measurement Uncertainty

Not applicable.

8 Limitations

The conclusions that can be reached from anthropological examinations to determine skeletal or non-skeletal origin are dependent on the condition and completeness of the submitted material. Results based on fragmentary or poorly preserved material may be inconclusive.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, eye protection, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Digital Radiography, Chemistry Unit, Metallurgy (current version)
- Operation of the EDAX Eagle III XXL Micro X-Ray Fluorescence Spectrometer, Chemistry Unit, Metallurgy (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Determination of Medicolegal Significance from Suspected Osseous and

Dental Remains (current version)

- Bone Histomorphology, Trace Evidence Procedures Manual (current version)
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
2	02/07/2018	<p>Updated title from osseous or dental to skeletal or non-skeletal and throughout document as appropriate.</p> <p>Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1.</p> <p>Updated Section 2.</p> <p>Added 'or Sample Selection' to Section 4 header.</p> <p>Clarified language in Section 5</p> <p>Updated title of document referenced in Section 5.1.2.</p> <p>In Section 5.1.4, removed citation for article.</p> <p>Section 5.2 header changed to Records and added section 5.2.1.</p> <p>Added heading for Section 5.2.2 and updated wording in Sections 5.2.2.1 to state that osseous or dental origin may also be specified as appropriate.</p>
3	02/10/2020	<p>Updated references in Section 10.</p> <p>'Sample Selection' removed from Section 4 title.</p> <p>Updated wording used in Sections 5, 5.1, 5.1.2, 5.1.3, and 5.1.4.</p> <p>Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout.</p>

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief -

Date: 02/07/2020

Anthropology Technical
 Leader -

Date: 02/07/2020

Estimation of Biological Profile

1 Scope

This document describes guidelines for estimating the biological profile (including sex, age, ancestry, stature, or other biological features) of human skeletal material by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8" CX or equivalent)
- Spreading calipers (digital or analog) capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10 or equivalent)
- 3-dimensional digitizer (MicroScribe G2 LX or equivalent)
- Personal protective equipment (e.g., lab coat, gloves, eye protection,)
- FORDISC 3.0 or equivalent
- Osteometric board (Paleo-Tech Field Osteometric Board or equivalent)
- Mandibulometer (Paleo-Tech Mandibulometer or equivalent)
- Radiography unit (NorthStar X-5000 X-radiography unit or Kubtec radiography unit or equivalent)
- Tape measure
- Human skeletal reference casts (e.g., complete skeletal reference case, age determination casts)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

The Forensic Anthropological Examinations Procedure will be followed. Depending on the completeness and condition of the skeletal remains as well as the nature of the case and examination request, the following biological parameters may be estimated using the procedures described. In some cases, one of the following techniques may be sufficient, while in other cases, multiple techniques may be required to support the conclusions.

Skeletal material will be compared to information or data from published literature and/or skeletal reference material. Any referenced literature will be cited in the case notes. Appropriate reference literature includes bone-, age-, sex-, and ancestry-specific studies appearing in peer-reviewed journals or textbooks. Skeletal reference material includes bones, bone replicas, and bone casts produced or used for the purpose of skeletal examination and comparison.

5.1 Procedures for Sex Assessment

Sex assessment is performed by non-metric and/or metric procedures that examine sexually dimorphic characteristics of the skeleton. If available, bones that are known to exhibit the greatest sexual dimorphism (e.g., pelvis, long bones, skull) will be examined, though other bones may also be used. Selection and application of sex assessment methods depend on the skeletal elements available for examination, their condition, and the general age of the individual (e.g., adult versus subadult). Generally, the estimation model with the highest correlation and the lowest standard error will be selected.

5.1.1 Morphoscopic (Non-Metric) Methods

Skeletal differences in morphological traits vary between the sexes by shape, features, and relative size. Methods based on the pelvis are preferred. Whichever methods are applied, bone-specific reference literature and/or casts, such as pubic sex determination casts will be used when available.

5.1.2 Metric Methods

Measurements used in sex estimation generally involve limb bone size and articular surface size. Metric techniques require bone-specific literature and/or software such as FORDISC. Multiple measurements and multivariate techniques will be used when possible. For metric procedures, measurements will be taken following methods described in appropriate reference literature, depending on the metric technique used. Reference material will be used according to the method described within, and cited in the case notes.

5.1.3 Subadult Sex Assessment

It is generally inadvisable to assess sex for fetal, infant, or child remains under ~12 years of age because valid sex assessment techniques are unavailable. In some instances, however, sex assessment of older adolescents may be possible.

5.2 Procedures for Age Estimation

Age estimation is based on evaluation of developmental or degenerative skeletal changes. The technique(s) used will be determined by the type, condition, and amount of remains present. Depending on the skeletal material available for analysis, the estimation model with the highest correlation and the lowest standard error will be selected.

In most cases, age estimation will be performed by visual examination and documentation of developmental or degenerative status. These techniques may require bone-specific reference

literature and casts (e.g., pubic age estimation casts and rib age estimation casts). To assess the status of material that cannot be seen visually (e.g., unerupted teeth), radiologic examination may be performed using digital radiology following the Chemistry Unit, Metallurgy Digital Radiography procedure. Reference material will be used according to the method described within, and cited in the case notes.

5.2.1 Age Estimation for Subadults

If teeth are present, they will be assessed for their stage of mineralization and/or eruption. This will typically require the use of radiology, but when possible may also involve direct visual examination. Dental development is more highly correlated with chronological age than bone development. Osseous development including appearance of ossification centers, long bone diaphyseal lengths, and epiphyseal union will also be used when available.

5.2.2 Age Estimation for Adults

Age estimation in adults generally involves assessment of degenerative and other skeletal changes. Certain methods are more reliable for particular periods of adult life. Valid methods include assessment of pubic symphyseal morphology, sternal rib ends, histological bone remodeling, as well as more general indicators of senility (e.g., osteoporosis, osteoarthritis, other age-related skeletal disease).

5.3 Procedures for Ancestry Estimation

Ancestry estimation is conducted by analyzing geographically-varying cranial non-metric and/or cranial and post-cranial metric characteristics commonly associated with individuals from particular geographic regions. Given the limited accuracy of the techniques available, results are usually considered suggestive rather than definitive. Depending on the skeletal element(s) available for analysis, the estimation model with the highest correlation and the lowest standard error will be selected.

5.3.1 Morphoscopic (Non-Metric) Methods

Morphoscopic techniques involve assessment of various traits and trait complexes that may suggest ancestry, requiring bone-specific reference literature.

5.3.2 Metric Methods

Metric techniques require bone-specific reference literature and FORDISC, which is considered the primary tool for metric estimation of ancestry. For metric procedures, measurements will either be taken using calipers, an osteometric board, a mandibulometer, and a tape measure according to appropriate reference literature, or using a 3D digitizer. Reference material will be used according to the method described within, and cited in the case notes.

5.4 Procedures for Stature Estimation

Stature estimation provides the most probable stature of an unknown individual by performing

calculations based on bone dimensions. Stature may be estimated by anatomical or regression methods as appropriate. Most stature estimation models use maximum length measurements of long bones. Depending on the skeletal element(s) available for analysis, the estimation model with the highest correlation and the lowest standard error will be used. Estimation models employed will be derived from an appropriate reference population, where available. Reference material will be used according to the method described within, and cited in the case notes.

5.4.1 Anatomical Method

All bones constituting the components of stature will be measured (cranial height, lengths of vertebrae bodies and first sacral segment, femoral and tibial lengths, and tarsal heights), measurements will be summed, and corrections applied for missing soft tissue. Alternatively, the sum of the skeletal elements may be employed in a regression formula. Measurements and calculations applied will follow the relevant published method.

5.4.2 Regression Method

Complete limb bone lengths will be measured and inserted into regression formulae appropriate by time period, sex, and ancestry. Univariate or multivariate formulae may be used. .

Methods based on fragmentary limb bones or non-limb bones may be used but are generally lower in precision and accuracy than those based on complete limb bones.

5.5 Other Biological Features

Other biological features of the skeleton that may further narrow the potential match pool may also be documented. Such features may include skeletal anomalies and pathologies. Anomalies include variants of the skeleton that are usually congenital or epigenetic in origin. Pathological conditions are changes in normal anatomy due to a disease process. Anomalies and pathologies can be identified by comparison to descriptions or images in reference literature.

5.5 Records

5.5.1 Case Notes

The case notes will include the resulting calculations and any significant observations leading to the estimation of sex, age, ancestry or stature. Notes will include the method(s) used as applicable, the estimate, the standard used, the prediction interval, the phase or category observed, the standard error/standard deviation, and models, exemplars or reference literature used. Supporting records (e.g., FORDISC printouts) and raw data will also be included with the case notes. Reasons for not providing a requested estimate will be recorded (e.g., appropriate bone not present).

5.5.2 Reports

The FBI *Laboratory Report* (7-1, 7-1 LIMS) will include at least the estimation(s), and some indication of the basis and strength of that conclusion. Where possible, the accuracy of the

estimate based on the method used will be given.

5.5.2.1 *Laboratory Reports* on the estimation of sex will include a conclusion of whether the assessment suggests “male” or “female”. For example: “*Qualitative assessment of the pelvis suggests male sex*” OR “*Quantitative assessment of the cranium suggests female sex, with a posterior probability of X.*” OR “*Measurements of the femoral head suggest female sex with a likelihood of 75%.*”

5.5.2.2 *Laboratory Reports* on the estimation of age will include an age interval. For example: “*The estimated age of the individual is approximately 35-45 years.*” OR “*The estimated age of the individual is 55 years or older.*”

5.5.2.3 *Laboratory Reports* on the estimation of ancestry will include a conclusion of whether the assessment suggests “European”, “African”, or “Asian” ancestry, some admixture of two or more groups, or other ancestral group as indicated by the method used. If FORDISC was used, the typicality and/or posterior probabilities may be reported. For example: “*Quantitative assessment of the cranium using suggests “White” (European) ancestry with a posterior probability of 75%, when compared to the following groups...*”

5.5.2.4 *Laboratory Reports* on the estimation of stature will include the point estimate and the prediction interval. For example: “*The estimated stature of the individual is 5’5” with a 95% confidence interval of 5’3”-5’7.*”

5.5.2.5 If no bones appropriate for estimating a particular parameter are present, or the condition of the bones does not permit a reliable estimate, the *Laboratory Report* will state this. For example: “*Stature could not be estimated from the available skeletal material.*”

6 Calculations

Calculations carried out as part of a biological profile will be performed according to appropriate reference data.

Calculations may be carried out in accordance with the prescribed method in the reference literature, or through the use of FORDISC. The source(s) of the formula(e) and calculations used will be recorded in the case notes.

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the calipers used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.3 The measurement uncertainty with the MicroScribe digitizer is less than 0.3 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological examinations for estimating the biological profile of skeletal remains are dependent on the condition and completeness of the remains. Results based on fragmentary or poorly preserved material may be inconclusive.

From studies of known individuals, suites of traits as well as metric relationships are understood to characterize certain groups; however, due to variation within the human species due to both genetic and external factors (such as diet and lifestyle), no particular feature or measurement is considered diagnostic of membership in any one particular group.

Due to differences in ancestral reporting standards, possible matches with individuals of ancestries other than those reported should not be excluded without further investigation.

9 Safety

9.1 While working with physical evidence, Laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, radiology units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Ousley SD and Jantz RL. (2005) FORDISC 3.0: Personal Computer Forensic Discriminant Functions. The University of Tennessee, Knoxville, Department of Anthropology
- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Sex Assessment (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Age Estimation (current version)

- Scientific Working Group for Forensic Anthropology guidelines for Stature Estimation (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Ancestry Estimation (current version)
- Digital Radiography, Chemistry Unit, Metallurgy (current version)
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
1	02/07/2018	<p>Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1.</p> <p>Updated Section 2.</p> <p>Removed Section 4 Calibration and renumbered.</p> <p>Added 'or Sample Selection' to new Section 4 title.</p> <p>Updated Section 5.1.2 to reference literature for metric procedures.</p> <p>Updated Section 5.1.3 by removing specificity regarding older adolescents.</p> <p>Section 5.2 changed macroscopic examination to visual.</p> <p>Section 5.2.1 updated for clarity.</p> <p>Section 5.3.and subsections updated to specify cranial and post-cranial, remove specific ancestry types, change non-metric to morphoscopic, and add 3D digitizer.</p> <p>In Sections 5.4.1 and 5.4.2, clarified measurements and calculations will follow published methods and removed reference to how calculations can be performed.</p> <p>Section 5.5 title changed to Records, updated wording for consistency in Section 5.5.1 and added <i>Laboratory Reports</i> instead of report in 5.5.2.</p> <p>Clarified wording in Sections 5.5.2.3 and 5.5.2.4.</p> <p>Updated Section 6.</p> <p>Updated Section 7 from uncertainty of measurement and added Section 7.3.</p> <p>Section 9.3 changed x-ray to radiology.</p> <p>Updated references in Section 10.</p>
2	02/10/2020	<p>Updated wording in Scope and Section 5.2.</p> <p>Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope.</p> <p>Removed 'Sample Selection' from Section 4 title.</p> <p>Added Section 5.5.</p> <p>Updated reference to Chemistry procedure.</p> <p>Changed Fordisc to FORDISC throughout for consistency.</p>

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief

Date: 02/07/2020

Anthropology Technical
 Leader

Date: 02/07/2020

Facial Approximation

1 Scope

This document describes the procedures for producing facial approximations as performed as a joint procedure between a forensic anthropologist and visual information specialist (VIS) within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Computer hardware that has storage, processing, and display capabilities that can handle uncompressed data
- Computer software (e.g., Adobe Photoshop and Adobe Illustrator)
- Transparency overlay
- Light table
- Miscellaneous drawing supplies including pencils, erasers, and drawing paper
- Resin
- Modeling clay
- Sculpting tools
- Personal protective equipment (e.g., lab coat, gloves, eye protection)

3 Standards and Controls

Not applicable.

4 Sampling or Sample Selection

Not applicable.

5 Procedure

Facial approximations are performed as a joint procedure between a forensic anthropologist and VIS.

5.1 Anthropological Examination

Facial approximation from skeletal remains will only be performed after an anthropological examination(s) has been conducted. This examination may take place within the FBI Laboratory, or prior to submission (in which case the evidence must be accompanied by an anthropological report). The evidence will be photographed by the forensic anthropologist prior

to being routed to the VIS. If an anthropological examination(s) is conducted within the FBI Laboratory, the Forensic Anthropological Examination Procedure and other appropriate procedures, will be followed.

5.2 Facial Approximation

5.2.1 The VIS will record the items of evidence received in the Case Record Communication Log.

5.2.2 At the discretion of the VIS and based on the nature and quality of the submitted evidence, the facial approximation may be either two-dimensional (e.g., drawing), three-dimensional (e.g., sculpting), or computer-generated.

5.2.3 Facial approximations will be based upon information provided with the evidence submission and in the anthropological report.

5.2.4 The facial approximation will be completed using the original evidence as a reference. In most cases the evidence will consist of a skull, though photos or computed tomography (CT) scans may be used on a case-by-case basis and at the discretion of the forensic anthropologist and VIS.

5.2.5 The VIS will coordinate with appropriate laboratory units to generate any required templates for the approximation (e.g., photographs for 2D or printed replica for 3D), and to records the completed approximation (e.g., photographs or printed replica of sculpture) as needed.

5.3 Consultation between Anthropologist and VIS

Following the completion of the approximation and prior to the release of the facial approximation to the contributor, the forensic anthropologist will provide consultation to the VIS to confirm consistency of the approximation with skeletal features. .

5.4 Records

5.4.1 Case Notes

The case notes for the anthropological examination will contain records appropriate to any anthropological examinations conducted (e.g., biological profile, trauma analysis). The case notes will also include the anthropological assessment of features to be considered by the VIS.

5.4.2 Reports

The FBI *Laboratory Report* (7-1, 7-1 LIMS) will include a summary of features to be considered by the VIS. For example: “*Features observed that should be considered for the facial approximation include a large, projecting nose, robust chin, moderately pronounced and V-shaped supraorbital ridge...*”

5.4.3 A *Laboratory Report* will be issued by the VIS summarizing the work completed, including a statement regarding the distribution of the work product. For example: “A *three-dimensional clay sculpture facial approximation was completed, and images can be found on the enclosed CD.*”

5.4.4 Approximations and/or associated media/files (e.g., photographs, electronic files) will be retained/recorded in the VIS’s case file where applicable. If a positive identification is effected (i.e., DNA, dental records), photographs of the identified individual, when available, will be added to the case file.

6 Calculations

Not applicable.

7 Measurement Uncertainty

Not applicable.

8 Limitations

8.1 The conclusions that can be reached from anthropological examinations are dependent on the condition and completeness of the remains, and the availability and quality of antemortem data.

8.2 The production of facial approximations is for investigative purposes and is not a means of identification.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, radiography units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- FBI Laboratory Safety Manual (current version)
- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Facial Approximation (current version).
- Neville, Wesley. *Composite Protocol*, Florence County Sheriff's Office Forensic Art Protocol Manual.

Rev. #	Issue Date	History
0	06/29/12	Original issue.
1	09/17/14	Updates to document to reflect LD reorganization in which forensic artists performing facial approximation are no longer in the Forensic Imaging Unit but in the Trace Evidence Unit. Procedures previously housed in FIU were merged into this document. Deleted section 4 and renumbered remaining sections. Changed title of newly numbered section 7. Updated references.
2	02/07/18	Updated title to reflect change from unit-specific. Updated Section 1, Scope and Section 2. Changed forensic artist to visual information specialist throughout. Added 'or Sample Selection' to Section 4 header. Moved language in former Section 5.4.3 to Section 5.2.1. In Section 5.2.4, added option to use photos or CT scans at discretion of forensic anthropologist and VIS. Updated wording in Section 5.3 for clarity. Section 5.4 header changed to 'Records' and added FBI Laboratory Report instead of report to Sections 5.4.2 and 5.4.3. Section 5.4.4, provided examples of how identification can be made. Removed Section 8.3. Updated references in Section 10.

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief

Date: 02/06/2018

Anthropology Technical
 Leader

Date: 02/06/2018

QA Approval

Quality Manager

Date: 02/06/2018

Operational Response and Field Assessments

1 Scope

This document describes guidelines for field deployments of Anthropology Examiners within the Trace Evidence Unit (TEU) to assist with the detection and recovery of potential human remains. This document also describes the procedures for field analysis and assessments.

2 Equipment/Materials/Reagents

- Personal protective equipment (e.g., gloves, protective footwear).

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

5.1 Operational Deployments

Operational assistance provided by examiners will be coordinated by the Evidence Response Team Unit (ERTU) and will conform to the deployment policies of the Operational Response Section (ORS). Assistance may include advising and/or participating in, for example:

- Detection of buried remains/ clandestine graves
- Excavation/recovery of buried remains
- Location of scattered skeletal remains
- Recovery of scattered skeletal remains
- Recovery of burned skeletal remains
- Recovery of submerged remains
- Field assessments

5.2 Field Assessments

Field assessments of recovered material may be performed. The possible conclusions that can be reached based on field assessments may be limited or inconclusive (typically, skeletal versus non-skeletal origin, and/or human versus non-human origin). At the discretion of the examiner, further laboratory analysis may be required to render a conclusion.

5.3 Records

5.3.1 The case notes and FBI *Laboratory Report* (7-1, 7-1 LIMS) will contain, at a minimum, any significant information pertaining to anthropological contributions to the detection, excavation, location, recovery, or assessment of potential human remains.

5.3.2 If a field assessment is provided, case notes will include observations supporting conclusions, and an indication of whether this material was collected as evidence, left *in situ*, or collected and disposed of in some other manner. Reporting will proceed according to the Determining Skeletal or Non-skeletal Origin procedure, Determining Human or Non-Human Origin procedure, or other applicable procedure.

5.3.3 When further laboratory analysis of recovered material is deemed necessary based on the examiner's discretion, the material will be submitted to the FBI Laboratory and examinations will be performed according to appropriate SOPs.

6 Limitations

The conclusions that can be reached from an anthropological field assessment are dependent on the condition and completeness of the remains, as well as the environmental conditions of the recovery location. Results based on fragmentary or poorly preserved material may be inconclusive, and laboratory analysis may be required.

7 Safety

7.1 While working in the field and/or with physical evidence, Laboratory personnel should wear at least the minimum appropriate protective attire (e.g., gloves, footwear appropriate to the environment). It is recognized that appropriate attire will vary depending on the field deployment context.

7.2 Universal precautions will be followed.

7.3 Exposure to biological hazards may be associated with operational response and field assessments. Safety procedures related to specific equipment or procedures will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

8 References

- Determining Skeletal or Non-skeletal Origin, Trace Evidence Procedures Manual (current version)
- Determining Human or Non-Human Origin, Trace Evidence Procedures Manual (current version)
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
1	02/07/2018	<p>Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1 and Section 5.1.</p> <p>Updated Section 2.</p> <p>Removed Section 4 Calibration and renumbered.</p> <p>Added 'or Sample Selection' to Section 4.</p> <p>Clarified in Section 5.2 what field assessments will cover and possible conclusions.</p> <p>Section 5.3 header changed to Records, in subsections 5.3.1, 5.3.2, 5.3.3, added FBI Laboratory Report instead of report, updated title of Anthropology SOP, and clarified when items would be submitted to Laboratory.</p> <p>Provided example in Section 7.1.</p>
2	02/10/2020	<p>Updated references in Section 8.</p> <p>Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout.</p> <p>Removed 'Sample Selection' from Section 4 title.</p> <p>Added 'to render a conclusion' to Section 5.2.</p>

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief

Date: 02/07/2020

Anthropology Technical
 Leader

Date: 02/07/2020

Personal Identification

1 Scope

This document describes guidelines for the comparison of antemortem and postmortem skeletal information, and assessing other skeletal features that may support or provide lead value or support a personal identification by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Digital radiography unit (NorthStar X-5000 x-radiography unit or Kubtek radiography unit or equivalent)
- Personal protective equipment (e.g., lab coat, gloves, eye protection)
- Digital camera (Nikon D70 or equivalent)
- Light box
- Stereobinocular microscope, magnification range from 0.5x to at least 40x

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

The Forensic Anthropological Examinations Procedure will be followed. Examiners may facilitate the identification process through the comparison of antemortem and postmortem skeletal information and looking for consistencies and inconsistencies that support or refute whether they originated from the same individual. Examiners may also assess the skeletal for features that may provide lead value or support a personal identification. One or more of the following approaches may be used.

5.1 Identification Comparison

An identification comparison is the direct comparison of antemortem skeletal information, typically in the form of radiologic images (e.g., radiographs, computed tomography (CT) scans, other medical imaging modalities) with postmortem information (typically radiologic images)

obtained from the skeletal remains. When antemortem radiographs are provided for comparison, the examiner will produce postmortem radiographs that simulate the antemortem radiographs in scope and projection following the Chemistry Unit, Metallurgy Digital Radiography Procedure or other instrument-specific procedures. Depending on whether the submitted radiographs are film or digital, the comparison may be performed using a computer screen or light box. Antemortem radiographs or CT scans can also be compared to postmortem CT scans. The forensic anthropologist will then compare the two images, looking for consistencies and inconsistencies in bone morphology, trabecular patterns, frontal sinuses, dental features, etc. Identification comparisons must be verified (see Section 5.4). Identification comparisons may result in one of the following conclusions:

5.1.1 Inclusion (i.e., included): An examiner's conclusion that the questioned skeletal information could have originated from the same individual as the known skeletal information, or from another individual with the same skeletal features.

The basis for an 'inclusion' conclusion is an examiner's decision that there is sufficient agreement between the features of the questioned and known skeletal information, with no unexplainable differences, to conclude that the skeletal information could have originated from the same individual or from another individual with the same skeletal features.

The strength of the agreement, based on relevant databases or published frequencies of shared skeletal feature(s), shall be reported, if known. If the frequency of the shared feature(s) is not known, the examiner shall disclose that the number of individuals who may also share the feature(s) is unknown.

5.1.2 Exclusion (i.e., excluded): An examiner's conclusion that the questioned and known skeletal information could not have originated from the same individual.

The basis for an 'exclusion' conclusion is an examiner's decision that the questioned and known skeletal information exhibit sufficient differences in skeletal features such that the questioned skeletal information could not have originated from the same individual as the known skeletal information.

5.1.3 Inconclusive: An examiner's conclusion that no determination can be reached as to whether the questioned and known skeletal information could have originated from the same individual.

The basis for an 'inconclusive' conclusion is an examiner's decision that there is insufficient quantity and/or quality of skeletal features in the known and/or questioned skeletal information to determine whether the skeletal information could have originated from the same individual or from another individual with the same skeletal features.

5.2 Skeletal Information That May Support an Identification

Other information obtained from the skeleton may provide lead value or support an identification, but does not involve the direct comparison of antemortem and postmortem skeletal information. This information will be recorded in the notes and reported as appropriate.

5.2.1 Surgical Implants

When surgical implants (e.g., surgical implements, artifacts, appliances, devices) are present with or within the remains, all information (e.g., lot number, serial number, stamp/symbol of the manufacturer) present on the device will be noted and reported. The information can be compared with industry repositories or historical records to determine the likely location and/or time period of use. In cases where the device appears in radiologic images, the device may be included as part of an identification comparison (see Section 5.1).

5.2.2 Biological Profile

Biological information estimated from the skeletal remains such as age, sex, ancestry, and stature may be assessed to determine whether it is consistent with recorded information or databases of missing persons (see Estimation of Biological Profile Procedure).

5.2.3 Charts and Notes

Written or charted medical and/or dental records that contain recorded features or patterns may be assessed to determine whether they are consistent with the skeletal remains.

5.2.4 Injuries, Anomalies, Pathological Conditions, and Lesions

When injuries, anomalies or pathological conditions are identified on the skeletal remains, they may be assessed to determine whether they are consistent with antemortem records or information. Most of these conditions can be observed macroscopically, and in some cases may be aided by the use of a stereobinocular microscope or radiographic examination. In cases where the condition is documented/captured in radiologic images, it may be included as part of an identification comparison (see Section 5.1).

5.2.5 Repetitive Mechanical Stress

Stresses and strain on an area of the skeleton from repetitive mechanical stress over time may leave marks on the skeleton in the form of: over-developed tubercles, crests, processes, and fossae; bowing or other changes in the diaphyses or articular facets; degenerative changes; or lesions. Often, asymmetries in robusticity, length, and density of paired bones may be indicative of such activity. Overexposure to some chemicals may leave marks on bone (e.g., spurring at the bone tendon interface as a result of fluorine toxicity or fluorosis). Facets, grooves, notches, fractures, premature wear, and lesions may be apparent in the dentition.

5.3 Records

5.3.1 Case Notes

The case notes will thoroughly record all observations of traits determined to be potentially useful for identification, and where appropriate will include diagrams, sketches and photographs, supplemented with written notes.

5.3.2 Reports

5.3.2.1 In cases where no antemortem data was provided, the FBI *Laboratory Report* (7-1, 7-1 LIMS) may indicate features or conditions that the examiner believes may be useful for identification or narrowing the pool of potential candidates. For example: “*The following skeletal conditions were noted and may be useful for personal identification if suitable antemortem records can be located for comparison.*” OR “*The skeletal remains include a surgical device marked serial number 99999, manufactured by Company X.*”

5.3.2.2 When antemortem records or data are provided and a direct comparison of antemortem and postmortem skeletal information is performed, the *Laboratory Report* will indicate one of the conclusions described in Section 5.1.

5.4 Verification

Identification comparisons involving known (antemortem) and questioned (postmortem) skeletal information (see Section 5.1) will be submitted for verification by a second qualified Anthropology Examiner. The verification will be recorded in Forensic Advantage (FA). If the second examiner does not reach the same conclusion, the disagreement will be addressed under the FBI Laboratory Operations Manual – Practices for Resolution of Scientific or Technical Disagreement.

6 Calculations

Calculations carried out as part of a biological profile will be performed according to appropriate reference data.

Calculations may be carried out in accordance with the prescribed method in the reference literature, or through the use of Fordisc. The source(s) of the formula(e) and calculations used will be recorded in the case notes.

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the caliper used. Refer to instrument manuals for uncertainty for a particular

caliper. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations. Measurements with calipers are recorded to the nearest mm.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations. Measurements with an osteometric board are recorded to the nearest mm.

8 Limitations

Ultimately, the conclusion regarding identification is made by the relevant medicolegal authority.

The conclusions that can be reached from anthropological examinations are dependent on the condition and completeness of the remains, and the availability and quality of antemortem data. Results based on fragmentary or poorly preserved material may be inconclusive.

9 Safety

9.1 While working with physical evidence, Laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Digital Radiography Procedure, Chemistry Unit, Metallurgy (current version).
- Ousley SD and Jantz RL. (2005) FORDISC 3.0: Personal Computer Forensic Discriminant Functions. The University of Tennessee, Knoxville, Department of Anthropology.
- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Estimation of Biological Profile, Trace Evidence Procedures Manual (current version)

- FBI Laboratory Safety Manual (current version)
- FBI Laboratory Operations Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Personal Identification (current version).
- Scientific Working Group for Forensic Anthropology guidelines for Identifying and Describing Pathological Conditions, Lesions and Anomalies (current version).
- Department of Justice Uniform Language for Testimony and Reports for the Forensic Anthropology Discipline (current version)

Rev. #	Issue Date	History
3	01/31/19	Updated Section 5.9.2.2 language to provide consistency with Department of Justice Uniform Language for Testimony and Reports for the Forensic Anthropology Discipline Updated Section 5.10 Changed 'forensic anthropologists' to 'anthropology examiners' throughout Changed 'documented' to 'recorded' throughout Added ULTR to references
4	12/16/19	Updated language in Sections 1, 5, 5.1, 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.3.2.2 Section 5.1 header changed to 'Identification Comparison' from 'Comparative Radiology' Moved conclusion language to Sections 5.1.1 through 5.1.3 Removed sections on Skull Photo Superimposition and Comparative Photograph Updated Section 5.4 to clarify types of examinations that get submitted for verification Changed Anthropology Examiner to 'examiner' in multiple sections outside of Scope.

Approval

Redacted - Signatures on File

Trace Evidence Unit
Chief

Date: 12/13/2019

Anthropology Technical
Leader

Date: 12/13/2019

Resolving Commingled Skeletal Remains

1 Scope

This document describes procedures for resolving commingled skeletal remains to include sorting and estimating either the minimum or likely number of individuals present by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX, or equivalent)
- Spreading calipers (digital or analog) capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10, or equivalent)
- Personal protective equipment (lab coat, gloves, eye protection or better, as needed)
- Reversible adhesive (Paraloid B-72 or equivalent)
- Permanent adhesive (cyanoacrylate or equivalent)
- Osteometric board (Paleo-Tech Field Osteometric Board or equivalent)
- Mandibulometer (Paleo-Tech Mandibulometer or equivalent)
- Tape measure
- Sand
- Wooden struts

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedures

The Forensic Anthropological Examinations Procedure will be followed. When there is reason to believe that more than one individual is present (e.g., through investigative information, duplication of skeletal elements determined in the skeletal inventory, differences in estimated biological features of skeletal elements), field recovery records (e.g., written documentation,

photographs, maps) will be reviewed if available. Such records may provide evidence of direct association of skeletal elements.

The examination will proceed to segregating and sorting the remains, and estimating the minimum or likely number of individuals represented. Provenience information collected during the recovery will be retained. Elements that were articulated at the time of recovery will be maintained as a unit throughout the analytical process where possible.

5.1 Procedure for Sorting/Segregating Commingled Remains

5.1.1 The skeletal remains will be inventoried and, at the discretion of the examiner, may be recorded on the Dental Chart and/or Skeletal Inventory Form, as appropriate, located in the appendices of the Forensic Anthropological Examinations Procedure.

5.1.2 Fragmented bones will be reassembled where appropriate and to the extent possible. In cases where reassembly will be facilitated by affixing fragments (e.g., extreme fragmentation or a large number of specimens), temporary adhesive and stabilizing equipment such as sand and struts may be used.

5.1.3 Bones will be sorted by element, side, size, estimated biological features and other criteria where applicable.

5.1.4 Bones will be associated with each other where possible using any or all of the following techniques:

- Visual pair-matching - the association of left and right elements based on similarities in morphology and size
- Articulation - the association of congruent elements based on closeness of fit at the joint or juncture with another bone
- Osteometric comparison - the association of elements based on statistical evaluation of size and shape relationships
- Taphonomy - the association of elements based on similarities in preservation (e.g., color, condition)

5.2 Procedure for Estimating the Number of Individuals

Estimating the number of individuals represented is typically determined by calculating the Minimum Number of Individuals (MNI). If preservation is good, another option is to calculate the Most Likely Number of Individuals (MLNI). Extremely fragmentary or poorly preserved remains may not be amenable to any meaningful quantification technique.

5.2.1 Minimum Number of Individuals

The MNI is the estimate for the minimum number of individuals that contributed to the sample. MNI is calculated by counting the most repeated element (or portion thereof), after sorting by element and side. When calculating MNI from fragmentary remains, every fragment used to

calculate the MNI must share a specific landmark. Additional individuals may be added to the MNI estimate based on differences in estimated biological features.

5.2.2 Most Likely Number of Individuals

The MLNI is used to estimate the *actual* number of individuals, as opposed to the *minimum* number. It is calculated based on the number of paired and unpaired bones. The formula for calculation of the MLNI is:

$$MLNI = [(L+1)(R+1)/(P+1)] - 1$$

where R= right, L= left, and P= pairs. Good preservation is necessary because it is critical that elements are accurately pair-matched.

5.3 Records

5.3.1 Case Notes

The case notes will include the elements present, the sorting and association techniques used, the number of individuals estimated, the basis of the estimate, and the method(s) and/or reference(s) used.

5.3.3 Reports

The FBI *Laboratory Report* (7-1, 7-1 LIMS) will include the number of individuals estimated, the method(s) used, and the basis of the estimate. For example: “*The minimum number of individuals present is 10, based on the repeated occurrence of complete right femora.*”

6 Calculations

Calculations carried out as part of commingling analysis will be performed according to appropriate reference data.

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the calipers used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological examinations for resolving commingling are dependent on the condition and completeness of the remains. Results based on fragmentary or poorly preserved material may be inconclusive.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Resolving Commingled Human Remains (current version).
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
1	02/07/2018	<p>Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1.</p> <p>Updated Section 2.</p> <p>Removed Section 4 Calibration and renumbered document.</p> <p>Added 'Sample Selection' to new Section 4.</p> <p>Updated Sections 5.1.1, 5.1.2, 5.1.3 for clarity.</p> <p>Updated Section 5.2.1 to add information about additional individuals may be added to the MNI estimate.</p> <p>Updated Section 5.3 to changes from Documentation to Records.</p> <p>Removed Section 5.3.2 on confirmation.</p> <p>For Section 5.3, added FBI Laboratory report to replace report.</p> <p>Updated Section 7 for consistency with Quality Assurance Manual.</p>
2	02/10/2020	<p>Updated references in Section 10.</p> <p>Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout.</p> <p>Removed 'Sample Selection' from Section 4 title.</p> <p>Updated wording in Section 5.1.2.</p>

Approval

Redacted - Signatures on File

Trace Evidence Unit
 Chief

Date: 02/07/2020

Anthropology Technical
 Leader

Date: 02/07/2020

Trauma Analysis

1 Scope

The following procedures are for describing, recording, and interpreting skeletal trauma by Anthropology Examiners within the Trace Evidence Unit (TEU). The terms in this section are defined as they apply to forensic anthropology, and may differ from terminology used in other disciplines/categories of testing.

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX or equivalent)
- Spreading calipers (digital or analog) capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10 or equivalent)
- Digital radiography unit (NorthStar X-5000 Digital X-radiography unit or Kubtek radiography unit or equivalent)
- Personal protective equipment (e.g., lab coat, gloves, eye protection)
- Digital camera (Nikon D70 or equivalent)
- Tape measure
- Stereobinocular microscope, magnification range from 0.5x to at least 40x
- Sandbox (capable of accommodating and stabilizing human bones and fragments)
- Sand
- Wooden struts
- Reversible adhesive (Paraloid B-72 or equivalent)
- Permanent adhesive (cyanoacrylate or equivalent)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

The Forensic Anthropological Examinations Procedure will be followed. Trauma is injury or disruption of living tissue by an outside force. The analysis of trauma requires the application of

elements of physics, biomechanics, materials engineering, ballistics, taphonomy, anatomy, and osteology.

Analysis of trauma will involve careful observation, thorough documentation, and interpretations will be based on scientifically valid methods and principles. A trauma analysis is typically performed by macroscopic, microscopic, and/or radiologic examination of the remains for evidence of traumatic alteration. Where possible, the examiner will attempt to assess the timing as well as the mechanism of trauma. Additionally, the examiner will describe postmortem alterations to the material.

5.1 Procedures for Classifying Trauma Timing

Characteristics and morphology of the alteration are used to determine when the trauma occurred relative to the death of the individual. Trauma timing may be classified as antemortem, perimortem, or postmortem

For the classification of trauma timing, the alteration will be examined visually. Examination may also include the use of a low magnification microscope and/or radiological analysis.

5.1.1 Antemortem Trauma

Antemortem trauma refers to an injury occurring prior to an individual's death. Antemortem trauma is classified on the basis of evidence of osteological activity in response to an injury. Features indicative of antemortem trauma include:

- Healed or healing fractures
- Pseudoarthrosis
- Trauma-induced degenerative joint disease
- Infectious response
- Surgically implanted devices.

5.1.2 Perimortem Trauma

Perimortem trauma refers to an injury occurring around the time of death, and when the skeletal tissue is in a biomechanically fresh state. Perimortem timing of trauma in anthropological examinations is classified on the basis of evidence of the biomechanical characteristics of fresh bone regardless of the temporal relationship to the actual death event. Trauma classified as perimortem may occur substantially after the death event and may be unrelated to the death event. Features indicative of perimortem trauma include:

- A lack of healing or infectious response
- Fresh bone fracture characteristics (e.g., plastic response)
- The absence of dry bone fracture characteristics (e.g., angular fractures)
- An overall fracture pattern characteristic of a terminal event (e.g., rapid deceleration event)

5.1.3 Postmortem Alterations

Postmortem alteration refers to taphonomic changes to bone after the individual's death and that are unassociated to the death event. Features indicative of postmortem alteration include:

- Differentially stained or recently exposed surfaces
- A lack of healing
- A lack of fresh bone fracture characteristics (e.g., plastic response)
- Pattern of damage (e.g., pitting, scoring and missing bone consistent with scavenging)

5.2 Procedures for Classifying Trauma Mechanism

For the classification of trauma mechanism, the alteration(s) will be examined using sufficient ambient and directed lighting. In some cases, low magnification microscopy and radiography will be used. When sufficient alterations are present, trauma may be classified as resulting from forces including blunt, sharp, high velocity projectile, or thermal exposure. Observed trauma patterns may be compared to literature or other reference material to aid in classification of mechanism. The following examinations will be performed, where applicable and appropriate, when assessing trauma mechanism:

- Examine and photograph fractured or incised surfaces.
- Examine cartilage for the presence of alterations prior to removal of soft tissues.
- Reconstruct fractured areas.
- Record alteration sites and provide descriptions, minimum and maximum measurements, and anatomic location. Measurements will be taken using calipers or a tape measure.
- Record the appearance and pattern of trauma with regard to fractures, missing bone, color changes, or other alterations.
- Estimate the minimum number and sequence of injuries, if possible. These are determined by the number of identifiable impact sites, and the intersections of fractures.
- Record the characteristics of the striking surface (e.g., circular, flat surface).
- Indicate the direction or orientation of the force or travel of projectiles relative to anatomy.
- Record whether projectile alterations are entry or exit sites based on the presence and direction of beveling.
- Look for linkages between articulated or localized bones to clarify possible patterns.
- Record intrusive materials or substances left by a tool when present at an impact site (e.g., hair trapped in bone) as well as any other associated evidence (e.g., soot or residue that may have been discharged from a gun).

5.2.1 Blunt Trauma

Blunt trauma is produced by low velocity impact from a blunt object (e.g., beating, motor vehicle accident, concussive wave) or the low velocity impact of a body with a blunt surface (e.g., fall).

Features indicative of blunt trauma include:

- Plastic deformation
- Delamination
- Fracture pattern indicating a low velocity impact site
- Location and characteristics of known clinical fractures (e.g., parry, Colles, tea cup, or overall patterns seen in auto collisions or falls from heights)
- Fractures in contiguous or anatomically related bones
- Tool marks or impressions indicating an impact site
- Beveling of concentric fractures in the cranial vault that indicate an external to internal force

5.2.2 Sharp Trauma

Sharp trauma occurs from edged, pointed or beveled objects striking or penetrating a bone.

Features indicative of sharp trauma include:

- Straight line incised alterations
- Punctures or gouges
- Chop or hack marks (clefts)
- Kerfs

5.2.3 High-Velocity Projectile Trauma

High-velocity projectile trauma is produced by impact from a projectile (e.g., gunshot, explosive-related) traveling at a high rate of speed. Features indicative of high-velocity projectile trauma include:

- The presence of a projectile in association with the bone
- Projectile entrance or exit characteristics
- The presence of residue, wipe, or remnants of the projectile present visually or radiographically
- Fracture patterns indicating a high velocity impact site
- Beveling of concentric fractures in bones of the cranial vault that indicate an internal to external force

5.2.4 Thermal Alteration

Thermal alteration to bone is produced by high temperature or direct contact with flame.

Features indicative of thermal alteration include:

- Color changes (e.g., yellow, black, white)
- Delamination

- Burn pattern
- Shrinkage
- Charring or calcinations
- Fractures

5.3 Records

5.3.1 Case Notes

Documentation of trauma will include descriptive text, photographs, diagrams and radiologic images, as applicable. The case notes will include, when determined, the classification of timing and mechanism of trauma, and observations leading to these conclusions including references to literature or other materials. The location and characteristics of the trauma will be described using measurements and standard anthropological and anatomical terminology. Alterations will be recorded on diagrams and/or in written descriptions. Other information such as direction and sequence will be recorded as appropriate, including the patterns or evidence to support the conclusion.

5.3.2 Reports

The FBI *Laboratory Report* (7-1, 7-1 LIMS) will include the assessed timing and mechanism of trauma, as well as other information including directionality and sequence, if determined. When a distinction cannot be made between antemortem, perimortem, or postmortem, this will be clearly stated.

For example:

- *“An antemortem (healed, before the time of death) fracture is present on Item 1.”*
- *“The alterations on Item 3 are consistent with a perimortem (around the time of death) projectile injury, entering on the left side and exiting on the right.”*
- *“The alterations on Item 5 are consistent with postmortem (after the time of death) carnivore scavenging.”*
- *“The timing of the skeletal trauma could not be determined.”*

6 Calculations

Not applicable.

7 Measurement Uncertainty

7.1 The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the caliper used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of measurement uncertainty does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

7.2 The measurement uncertainty with an osteometric board is approximately ± 0.5 mm. This degree of measurement uncertainty does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological examinations assessing the timing and mechanism of skeletal trauma are dependent on the condition and completeness of the remains. Results based on fragmentary or poorly preserved material may be inconclusive.

Studies of skeletal trauma have revealed patterns that are governed by bone biomechanical properties and show relationships with certain known causes. However, due to the variety and complexity of factors that may contribute to disruption of skeletal tissues, it is not always possible to determine trauma mechanism or timing with certainty.

9 Safety

9.1 While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Digital Radiography, Chemistry Unit, Metallurgy (current version)
- FBI Laboratory Safety Manual (current version)
- Scientific Working Group for Forensic Anthropology guidelines for Trauma Analysis (current version)

Rev. #	Issue Date	History
1	02/05/2018	Updated throughout removing references to TEU where appropriate; added forensic anthropologists to the Scope in Section 1 and Section 5. Updated Section 2. Removed Section 4 Calibration and renumbered. Added 'or Sample Selection' to new Section 4 title. Updated Sections 5, 5.1, 5.1.2, 5.1.3, 5.2, 5.2.1, 5.2.2, 5.3, 5.3.2, and Sections 7 for clarity.
2	02/10/2020	Updated references in Section 10. Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout. Removed 'Sample Selection' from Section 4 title. Replaced 'trauma' with 'alteration' in Section 5.2.4.

Approval

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Trace Evidence Unit
Chief

Date: 02/07/2020

Anthropology Technical
Leader

Date: 02/07/2020

Postmortem Photographic Alteration

1 Scope

This document describes procedures for completing photographic alterations of images of deceased individuals by the Visual Information Specialist (VIS) within the Trace Evidence Unit (TEU). Typical requests include removing signs of trauma and debris from the facial image (e.g., blood, dirt, bruises, clouded or closed eyes), correcting image distortion, and rebuilding features to depict the person as living (e.g., opening eyes, closing mouth, adding neck and shirt). This is a generally-accepted process, and is not meant to exclude or limit the use of variations of these procedures as each situation may require.

2 Equipment/Materials/Reagents

Equipment and materials used may include some or all of the following, as determined by the VIS, based on the request received:

- Computer with storage, processing, and display capabilities that can handle uncompressed data.
- Computer hardware associated with image manipulation (e.g., monitor, keyboard, mouse, graphics tablet, stylus, scanner)
- Computer software (e.g., Adobe Photoshop, Macromedia Freehand, Adobe Illustrator, and Microsoft PowerPoint.)
- Public domain visual representations of logos, tattoos, jewelry, clothing, etc.
- Public domain photos of human visual elements.
- Online image databases, news sources, and magazines, etc.
- Manual drawing supplies (e.g., pencils, erasers, paper).

3 Standards and Controls

Not applicable.

4 Sampling or Sample Selection

Not applicable.

5 Procedures

5.1 Review request from submitting law enforcement agency or partner.

5.2 Conduct preliminary review of the image(s) provided, if any, by contributor to determine their usefulness. Appropriate images showing unobstructed views of the face from multiple angles will be selected by the VIS based on the quality and quantity of images

submitted and the nature of the request.

5.3 If needed, additional imagery for either human visual elements or non-human visual elements (e.g., accessories, clothing) may be used to aid in the production of the photographic alteration. Additional imagery should be preferentially selected from FBI in-house visual reference sources. Other sources (e.g., internet, magazines, arrest photos) may be used when necessary. Identified individuals and royalty-free sources should be preferentially used. Sources of imagery, including any relevant copyright information, will be recorded in the case file.

5.4 Selected imagery will be downloaded or scanned.

5.5 Selected images and photo-retouching techniques will be used to produce the altered image. The technique(s) used may be manual or computer-based at the discretion of the VIS. Digital retouched images are created in Adobe Photoshop or equivalent software; however, there may be instances where the images are extracted from or delivered via other software such as FreeHand, Illustrator, or PowerPoint.

5.6 The final image will be scanned, if hand-drawn sketch, and saved to digital media.

6 Records

6.1 An FBI *Laboratory Report* (7-1, 7-1 LIMS) will be issued by the VIS summarizing the work completed, including a statement regarding the distribution of the work product (i.e., retouched image).

6.2 Images and/or associated media/files (e.g., photographs, electronic files) will be retained/recorded in the VIS's case file where applicable.

7 Calculations

Not applicable.

8 Measurement Uncertainty

Not applicable.

9 Limitations

Postmortem photographic alterations are for investigative purposes, and should not be considered to be an exact likeness of the individual during life.

10 Safety

Not applicable.

11 References

Neville, Wesley. *Composite Protocol*, Florence County Sheriff's Office Forensic Art Protocol Manual.

FBI Facial Identification Catalog, Federal Bureau of Investigation Laboratory Division. 2007.
Equipment and software specific manuals.

Rev. #	Issue Date	History
0	08/11/16	New document. Procedure previously existed in the Forensic Imaging Unit.
1	02/07/18	Updated title to reflect change from unit-specific. Updated Section 1, Scope and Section 2. Changed forensic artist to visual information specialist throughout. Added 'or Sample Selection' to Section 4 header. Updated Sections 5.2, 5.3, 5.6 and 6.1 for clarity and removed Section 5.7.

Approval

Redacted - Signatures on File

Trace Evidence Unit
Chief

Date: 02/06/2018

QA Approval

Quality Manager

Date: 02/06/2018

Assessment of Medicolegal Significance of Human Skeletal Remains

1 Scope

This document describes guidelines for assessing whether human skeletal material is of medicolegal significance by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX or equivalent)
- Spreading calipers capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10 or equivalent)
- Osteometric board (Paleo-Tech Field Osteometric Board, or equivalent)
- Mandibulometer (Paleo-Tech Mandibulometer or equivalent)3-dimensional digitizer (MicroScribe G2 LX or equivalent)
- Tape measure
- FORDISC 3.0 or more recent version
- Personal protective equipment (lab coat, gloves, eye protection, or better, as needed)
- Digital radiography unit (NorthStar X-5000 x-radiography unit, Kubtec radiography unit, or equivalent)
- Human skeletal reference casts (e.g., complete skeletal reference case, age determination casts)
- Stereobinocular microscope, magnification range from 0.5x to at least 40x
- Reversible adhesive (Paraloid B-72 or equivalent)
- Permanent adhesive (cyanoacrylate or equivalent)
- Digital camera (Nikon D70, or equivalent)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

The Forensic Anthropological Examinations Procedure will be followed. The assessment of medicolegal significance refers to determining whether remains are of interest to the medicolegal death investigation system (i.e., for identification or determination of cause and manner of death). For anthropological cases, medicolegal significance typically refers to cases that are skeletal in origin, human in origin, and recent in origin. Most jurisdictions do not have a legal or scientific definition for the time period that characterizes remains as medicolegally significant.

Conclusions regarding medicolegal significance are typically based on taphonomic alterations, biocultural factors, the context of the recovery scene, biological profile, and any artifacts associated with the remains. Examples of *non*-medicolegally significant remains include those from archaeological or prehistoric contexts, disturbed cemeteries, anatomical teaching collections, and wartime souvenirs (i.e., “trophy skulls”). It is noted that non-medicolegally significant remains may still be the subject of other criminal investigations and therefore of forensic importance. When conclusions regarding medicolegal significance are unclear, the default assumption will be that they are of medicolegal significance and appropriate procedures will be followed.

Rather than suggesting a specific conclusion, the following features are provided as guidelines for consideration in the assessment of medicolegal significance. For observations leading to a specific conclusion in a case, relevant reference literature will be used and cited. Appropriate reference literature includes relevant studies appearing in peer-reviewed journals or edited volumes and texts. Skeletal reference material includes bones, bone replicas, and bone casts produced or used for the purpose of skeletal examination and comparison.

5.1 Taphonomic Alterations

Taphonomic features relevant to the assessment of medicolegal significance are those that affect the appearance, quality and preservation of remains, including:

- Condition of soft tissue (e.g., present, absent, mummified)
- Bone preservation (e.g., hydrated/greasy, weathered, deteriorated)
- Embalming practices (e.g., procedures, chemicals)
- Features typical of anatomical teaching specimens (e.g., drill holds, hardware, patina)
- Features typical of wartime souvenirs (e.g., paint, inscriptions)

5.2 Biocultural Factors

Biocultural factors refer to skeletal adaptations and modifications that result from practices or activities which can often be associated with particular cultures or time periods. In some cases, assessment of ancestry may also be relevant. Biocultural factors relevant to assessment of medicolegal significance include:

- Occlusal attrition (e.g., as in prehistoric Native Americans)
- Cranial deformation (e.g., as in ancient Peruvian populations)
- Trephination
- Dental restorations
- Surgical devices

5.3 Context and Artifacts

Context and artifacts refer to features and items associated with but not inherent to the skeletal remains. Contextual information and artifacts relevant to the assessment of medicolegal significance include:

- Location of recovery (e.g., surface vs. burial, proximity to known cemeteries)
- Personal effects (e.g., clothing, jewelry, driver's license, currency)
- Coffin materials and hardware
- Stone tools and pottery
- Projectile points
- Burial features (e.g., body position, arrangement)

5.4 Recommendations for Disposition and Further Testing

In cases where remains are determined *not* to be of medicolegal significance, guidance may be provided to the contributor regarding the disposition of the remains. For example, in cases of Native American remains, the contributor should be advised of legislation regarding repatriation of such remains, and/or provided guidance on contacting the state archaeologist.

In some cases, additional testing of remains or artifacts (e.g., radiocarbon dating) may be suggested if more information regarding antiquity is requested.

5.5 Records

5.5.1 Case Notes

Case notes will include any significant observations leading to conclusions regarding medicolegal significance, such as descriptive text, photographs, diagrams, printouts (e.g., FORDISC results), and radiographs. Supporting records and raw data will also be included with the case notes. Reasons for not providing an assessment will be recorded (e.g., insufficient/lack of material present).

5.5.2 Reports

Based on the examination request and the discretion of the examiner, the final FBI *Laboratory Report* (7-1, 7-1 LIMS) will include, where relevant, descriptions of taphonomic alterations, ancestry estimates, and their implications for possible medicolegal significance.

5.5.2.3 *Laboratory Reports* will include a conclusion regarding whether remains are

medicolegally significant. For example: *“The remains are consistent with prehistoric origin and are therefore not of medicolegal significance.”* OR *“The remains cannot be excluded as being of possible medicolegal significance.”*

6 Calculations

Calculations carried out as part of a biological profile will be performed according to appropriate reference data.

Calculations may be carried out in accordance with the prescribed method in the reference literature, or through the use of FORDISC. The source(s) of the formula(e) and calculations used will be recorded in the case notes.

7 Measurement Uncertainty

The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the calipers used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of measurement uncertainty does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological assessments of medicolegal significance are dependent on the condition and completeness of the remains, as well as knowledge of the recovery context and depositional environment. Results based on fragmentary or poorly preserved material or on limited contextual information may be inconclusive.

9 Safety

9.1 While working with physical evidence, Laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- FBI Laboratory Safety Manual (current version)
- Pokines JT. Taphonomic characteristics of former anatomical teaching specimens received at a Medical Examiner's office, MA. *Journal of Forensic Identification* 2015;65:173-195.
- Sledzik PS, Ousley S. Analysis of six Vietnamese trophy skulls. *Journal of Forensic Sciences* 1991;36(2):520-530.
- Scientific Working Group for Forensic Anthropology guidelines for Determination of Medicolegal Significance (current version).
- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)

Rev. #	Issue Date	History
0	02/07/2018	Original issue.
1	02/10/2020	Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout. Removed 'Sample Selection' from Section 4 title. Updated fordisc to FORDISC throughout for consistency. Updated wartime souvenirs example in Section 5.1.

Approval

Redacted - Signatures on File

Trace Evidence Unit
Chief

Date: 02/07/2020

Anthropology Technical
Leader

Date: 02/07/2020

Assessment of Taphonomic Alterations

1 Scope

This document describes guidelines for assessing taphonomic changes to remains and skeletal material by Anthropology Examiners within the Trace Evidence Unit (TEU).

2 Equipment/Materials/Reagents

- Sliding calipers capable of measuring items up to 200mm within +/- 0.5mm (Mitutoyo Digimatic Absolute Digital Calipers 500-172-20 CD-8"CX or equivalent)
- Spreading calipers capable of measuring items up to 300mm within +/- 0.5mm (Paleo-Tech Digital Linear Spreading Calipers with Mitutoyo Digimatic Absolute Digital Scale 572-213-10 or equivalent)
- Osteometric board (Paleo-Tech Field Osteometric Board, or equivalent)
- Mandibulometer (Paleo-Tech Mandibulometer or equivalent)
- Tape measure
- FORDISC 3.0 or more recent version
- Personal protective equipment (e.g., lab coat, gloves, eye protection)
- Digital radiography unit (NorthStar X-5000 digital radiography unit or Kubtec radiography unit or equivalent)
- Human skeletal reference casts (e.g., complete skeletal reference case, age determination casts)
- Stereobinocular microscope, magnification range from 0.5x to at least 40x
- Reversible adhesive (Paraloid B-72 or equivalent)
- Permanent adhesive (cyanoacrylate or equivalent)
- Digital camera (Nikon D70, or equivalent)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

The Forensic Anthropological Examinations Procedure will be followed. The assessment of taphonomic alterations may be performed for the purposes of documenting changes to soft tissues and/or skeletal tissues, differentiating taphonomic alterations from antemortem or

perimortem trauma, and estimating the postmortem interval (PMI).

Any referenced literature will be cited in the case notes. Appropriate reference literature includes relevant studies appearing in peer-reviewed journals or edited volumes and texts. Skeletal reference material includes bones, bone replicas, and bone casts produced or used for the purpose of skeletal examination and comparison.

5.1 Procedure for Assessing Soft Tissue Taphonomic Alterations

Following death, cellular and microbial processes (autolysis and putrefaction) result in changes to and reduction of soft (i.e., non-skeletal) tissues of the body. Examinations of soft tissues may include visual, microscopic, and/or radiologic analysis.

Relevant information regarding the condition of soft tissues may include:

- Presence/absence of tissue
- Presence/absence of associated odor
- Color
- Distribution of tissue
- Bloating
- Marbling
- Skin slippage
- Mummification
- Saponification

In some cases, the condition of soft tissues may be scored according to published classification systems.

5.2 Procedure for Assessing Skeletal Taphonomic Alterations

Skeletal tissues are subject to modification by factors in the depositional environment. Relevant information regarding the condition of skeletal tissue may include:

- Well preserved/poorly preserved
- Staining/color
- Root presence/etching
- Weathering (e.g., bleaching, cracking, flaking, warping, erosion)
- Scavenging (e.g., disarticulation, missing bone, pitting, scoring, striations). In some cases, certain modifications can be associated to a particular scavenging group (e.g., carnivore, rodent).

5.3 Procedure for Postmortem Interval Estimation

Postmortem interval estimation is typically based on the degree of soft tissue and/or skeletal taphonomic alteration, often combined with knowledge of the depositional environment, and usually derived from case study analyses and climate-specific research. In many cases, these estimates are qualitative and broad. In some cases, scoring systems and associated formula(e) may be used. The method used, scores, and calculations will be recorded in the case notes.

5.4 Records

5.4.1 Case Notes

Case notes will include any significant observations leading to conclusions regarding the source/mechanism of a particular taphonomic observation, such as descriptive text, photographs, diagrams, printouts (e.g., FORDISC results), and radiologic images. Descriptions will include the location and characteristics of taphonomic alterations using anatomical terms and measurements, where applicable. In cases involving PMI estimation, notes will include the method(s) selected, as applicable, the estimate, the standard used, the prediction interval, the phase or category observed, the standard error/standard deviation, and models, exemplars or reference literature used. Supporting records and raw data will also be included with the case notes. Reasons for not providing a requested estimate will be recorded (e.g., insufficient/lack of material present).

5.4.2 Reports

Based on the examination request and at the discretion of the examiner, the final FBI Laboratory Report (7-1, 7-1 LIMS) will include, where relevant, descriptions of taphonomic alterations, their sources, and their implications for the postmortem interval. Where possible, the accuracy of the postmortem interval estimate based on the method used will be provided.

5.4.2.1 *Laboratory Reports* on the assessment of soft tissue alterations will include a description of quantity and/or quality. For example: “*Soft tissues are absent*” OR “*Adhering desiccated soft tissue is present.*”

5.4.2.2 *Laboratory Reports* on the assessment of skeletal tissue alteration will include a description of quantity and/or quality as well as the source of the alteration where possible. For example: “*Missing bone and striations are consistent with rodent gnawing*” OR “*The bone is weathered, including bleaching and exfoliation.*”

5.4.2.3 *Laboratory Reports* on the estimation of postmortem interval will include the estimate and prediction interval where possible. For example: “*The postmortem interval is approximately 6-12 months*” OR “*The postmortem interval is greater than one year.*”

6 Calculations

Calculations carried out as part of a biological profile or postmortem interval will be performed according to appropriate reference data.

Calculations may be carried out in accordance with the prescribed method in the reference literature, or through the use of FORDISC. The source(s) of the formula(e) and calculations used will be documented in the case notes.

7 Measurement Uncertainty

The measurement uncertainty with calipers is approximately ± 0.02 mm or better, depending on the calipers used. Refer to instrument manuals for uncertainty for a particular caliper. This degree of uncertainty of measurement does not significantly affect anthropological conclusions and is not detrimental to the results of anthropological examinations.

8 Limitations

The conclusions that can be reached from anthropological examinations assessing taphonomic alterations are dependent on the condition and completeness of the remains, as well as knowledge of the depositional environment. Results based on fragmentary or poorly preserved material or limited information on the depositional environment may be inconclusive.

Due to the number variables that affect postmortem tissue changes, the postmortem interval provided is an estimate. With increasing length of the postmortem interval, fewer methods are available and are typically less precise.

9 Safety

9.1 While working with physical evidence, Laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).

9.2 Universal precautions will be followed.

9.3 Exposure to biological and radiological hazards may be associated with the examination techniques performed. Safety procedures related to specific instruments or equipment (e.g., wafering saws, X-ray units) will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

10 References

- FBI Laboratory Safety Manual (current version)
- Megyesi MS, Nawrocki SP, Haskell NH. Using accumulated degree-days to estimate the postmortem interval from decomposed human remains. *Journal of Forensic Sciences* 2005; 50(3):1-9.
- Scientific Working Group for Forensic Anthropology guidelines for Taphonomic Observations in the Postmortem Interval (current version).
- Scientific Working Group for Forensic Anthropology guidelines for Trauma Analysis (current version).
- Forensic Anthropological Examinations, Trace Evidence Procedures Manual

(current version)

Rev. #	Issue Date	History
0	02/07/2018	Original issue.
1	02/10/2020	Changed 'forensic anthropologist' to 'Anthropology Examiner' in Scope and 'examiner' throughout. Removed 'Sample Selection' from Section 4 title. Updated Fordisc to FORDISC throughout for consistency. Updated examples for Section 5.2 Scavenging.

Approval

Redacted - Signatures on File

Trace Evidence Unit
Chief

Date: 02/07/2020

Anthropology Technical
Leader

Date: 02/07/2020

Assessment of Images

1 Scope

This document describes the procedure for assessing electronic images by Anthropology Examiners within the Trace Evidence Unit (TEU). An image assessment is a review of electronic evidence prior to or instead of receipt of physical evidence, primarily for the purpose of facilitating the expeditious determination of whether the depicted material is probative or relevant to an investigation (typically whether the depicted material is of human skeletal origin).

2 Equipment/Materials/Reagents

- Computer or mobile device
- Human and non-human skeletal reference material (e.g., casts, published literature, or museum collections)

3 Standards and Controls

Not applicable.

4 Sampling

Not applicable.

5 Procedure

5.1 Receipt of Images

Images may be received by email or SMS (text message). Ideally, images include a scale and appropriate considerations for lighting, angle, obstructions, etc. If the examiner believes that additional or different images may help the assessment, they may be requested from the contributor. There are no file size/type requirements for anthropological image assessments.

5.2 Scope of Image Assessments

An image assessment typically includes determining whether the depicted material is skeletal versus non-skeletal in origin (see SOP for Determining Skeletal or Non-skeletal Origin), or human versus non-human in origin (see SOP for Determining Human or Non-human Origin). Such assessments, by their nature, can only be performed visually based on the content of the

image. Results may also be inconclusive due to either image quality or the nature of the depicted item(s). As appropriate, the examiner may also advise the contributor that direct examination of the depicted item may provide additional information.

5.3 Expedited Results

Results of assessments will be provided to the contributor (either verbally or electronically) prior to technical and administrative review, including caveats in accordance with the LOM – Practices for Preparing, Reviewing, and Issuing Laboratory Reports and Retaining Records in Forensic Advantage (FA).

5.4 Administrative Procedures

The contributor will be advised of the procedure for submitting a request letter or Laboratory Examination Request (LER). Once received, the request will be forwarded to the Evidence Management Unit for entry into FA. Alternatively, the electronic request and results can be uploaded into Sentinel as a record email if a request letter or LER is unable to be obtained.

Once an anthropology case record has been created in FA, an entry will be placed in the Case Communication Log documenting the communication of expedited results to the contributor.

The evidence items and descriptions will be added in FA. The evidence naming convention will include that the evidence is electronic, and the original image file name, for example: “Item 1 Electronic Evidence (Photo1.JPG).” Actual image files may be documented in the Case Notes (see Section 5.5.1) and do not need to be separately uploaded to FA.

After the administrative review has been completed, the evidence will be placed into archive.

5.5 Records

5.5.1 Case Notes

The case notes will include the date and method of receipt of the images, as well as a copy of each image submitted.

5.5.2 Reports

The FBI *Laboratory Report* (7-1, 7-1 LIMS) will include the conclusion(s) reached based on the image assessment. The Remarks section will indicate that the evidence was received electronically and is being retained.

6 Calculations

Not applicable

7 Measurement Uncertainty

Not applicable

8 Limitations

The conclusions that can be reached from anthropological examinations to determine skeletal or non-skeletal origin are dependent on the condition and completeness of the submitted material. Results based on fragmentary or poorly preserved material may be inconclusive.

The conclusions that can be reached regarding human or non-human origin are dependent on the condition and completeness of the skeletal remains. Result based on fragmentary or poorly preserved material may be inconclusive.

The conclusions that can be reached based on the examination of images are dependent on the condition and completeness of the depicted skeletal material as well as the quality of the images. Results may be limited or inconclusive.

9 Safety

Not applicable.

10 References

- Forensic Anthropological Examinations, Trace Evidence Procedures Manual (current version)
- Determining Skeletal or Non-skeletal Origin, Trace Evidence Procedures Manual (current version)
- Determining Human or Non-human Origin, Trace Evidence Procedures Manual (current version)
- FBI Laboratory Safety Manual (current version)

Rev. #	Issue Date	History
0	12/16/19	Original issue.

Approval

Redacted - Signatures on File

Trace Evidence Unit
Chief

Date: 12/13/2019

Anthropology Technical
Leader

Date: 12/13/2019