Trauma Analysis

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1 INTRODUCTION

This document describes procedures are for describing, recording, and interpreting skeletal trauma. The terms in this document apply to forensic anthropology, and may differ from terminology used in other disciplines/categories of testing.

2 SCOPE

This document applies to Anthropology Examiners in the Trace Evidence Unit (TEU).

3 EQUIPMENT

- General laboratory supplies
- Personal protective equipment (e.g., lab coat, gloves, eye protection)

4 PROCEDURE

A. The Forensic Anthropological Examinations Procedure will be followed.
B. Trauma refers to injury or disruption of living tissue by an outside force.
C. The analysis of trauma requires the application of elements of physics, biomechanics, materials engineering, ballistics, taphonomy, anatomy, and osteology.
D. Analysis of trauma will involve careful observation, thorough documentation, and interpretations will be based on scientifically valid methods and principles.
E. A trauma analysis is typically performed by macroscopic, microscopic, and/or radiologic examination of the remains for evidence of traumatic alteration. Where possible and depending on the needs of the examination, the examiner will assess the timing as well as the mechanism of trauma.
F. Postmortem alterations to the material will also be documented.

4.1 Classifying Trauma Timing

A. Characteristics and morphology of the alteration are used to determine when the trauma occurred relative to the death of the individual.
B. Trauma timing may be classified as antemortem, perimortem, or postmortem.
C. For the classification of trauma timing, the alteration will be examined visually at a minimum; examination may also include the use of a microscopy and/or radiologic analysis.

4.1.1 Antemortem Trauma

A. Antemortem trauma refers to an injury occurring prior to an individual's death.
B. Antemortem trauma is classified on the basis of evidence of osteological activity in response to an injury.
C. Features associated with antemortem trauma include:
    - Healed or healing fractures
    - Pseudoarthrosis

- Trauma-induced degenerative joint disease
- Infectious response
- Surgically implanted devices.

4.1.2 Perimortem Trauma

A. Perimortem trauma refers to an injury occurring around the time of death, and when the skeletal tissue is in a biomechanically fresh state.
B. 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 therefore occur substantially after the death event and may be unrelated to the death event.
C. Features associated with 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)

4.1.3 Postmortem Alterations

A. Postmortem alteration refers to taphonomic changes to bone after death and that are typically unassociated to the death event.
B. Features associated with 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)

4.2 Classifying Trauma Mechanism

A. For the classification of trauma mechanism, the alteration(s) will be examined visually at a minimum using sufficient ambient and directed lighting. Low magnification microscopy and radiography may also be used.
B. When sufficient evidence is present, trauma may be classified as resulting from forces including blunt, sharp, high velocity projectile, or thermal exposure.
C. Observed trauma patterns may be compared to literature or other reference material to aid in classification of mechanism.
D. 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.
    - Examine fracture surfaces (prior to any reconstruction).
    - Reconstruct fractured areas as needed to visualize fracture patterns.

- Record alteration sites and provide relevant descriptions, including minimum and maximum measurements, and anatomic location.
- 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 impacting 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).

4.2.1 Blunt Trauma

A. 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).
B. Features associated with 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

4.2.2 Sharp Trauma

A. Sharp trauma is produced by edged, pointed or beveled objects striking or penetrating a bone.
B. Features associated with sharp trauma include:
    - Straight line incised alterations
    - Punctures or gouges
    - Chop or hack marks (clefts)
    - Kerfs

4.2.3 *High-Velocity Projectile Trauma*

A. High-velocity projectile trauma is produced by impact from a projectile (e.g., gunshot, explosive-related) traveling at a high rate of speed.
B. Features associated with 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 (such as cone cracks) indicating a high velocity impact site
    - Beveling of concentric fractures in bones of the cranial vault that indicate an internal to external force

4.2.4 *Thermal Alteration*

A. Thermal alteration to bone is produced by high temperature or direct contact with flame.
B. Features associated with thermal alteration include:
    - Color changes (e.g., yellow, black, white)
    - Delamination
    - Burn pattern
    - Shrinkage
    - Charring or calcinations
    - Fractures

5 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.

6 SAFETY

- While working with physical evidence, laboratory personnel will wear at least the minimum appropriate protective attire (e.g., laboratory coat, safety glasses, protective gloves).
- Universal precautions will be followed.
- Exposure to physical, biological, and chemical hazards may be associated with the examination techniques performed. Safety procedures related to specific materials, instruments or equipment will be followed. Refer to the FBI Laboratory Safety Manual for guidance.

7 REFERENCES

ANTHRO-300: Forensic Anthropological Examinations (current version)

FBI Laboratory Safety Manual (current version)

8 REVISION HISTORY

Revision	Issued	Changes
02	02/10/2020	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.
03	01/28/2022	Formatting and language changes to conform to new template.