

Identifying and Describing Pathological Conditions, Lesions and Anomalies

1.0 Principle, Spirit and Intent

Skeletal remains will be examined in a systematic manner for the purpose of identifying, describing and documenting pathological conditions, lesions and anomalies that may be relevant to the identification of unknown human remains and the circumstances surrounding death. The examination will be performed in a manner that permits a differential diagnosis to be developed as well as the independent replication and verification of the work performed and the conclusions drawn.

2.0 Purpose and Scope

These guidelines outline procedures for documenting and reporting pathological conditions, lesions and anomalies by comparison with standard exemplars and models derived from documented clinical and research cases with comparable diagnostic criteria. The pathological conditions and anomalies detailed in these guidelines represent pre-existing conditions, often chronic, that occurred well before death and are, therefore, relevant to human identification efforts.

These guidelines are intended for practitioners within a variety of work environments; practitioners may be employed in an identification laboratory, in a university setting, a coroner/medical examiner's office, or as a private consultant for a police or sheriff's department. Practitioners of forensic anthropology should implement these guidelines to the fullest extent as applicable, practical and appropriate. In the absence of specific guidelines or in the case of conflicting procedures, the principle, spirit and intent should be met.

3.0 General Principles

The description and documentation of pathological conditions, lesions and anomalies (including "normal" variation) in the human skeleton can be extremely useful in helping to develop a presumptive identification and/or by confirming the identity of unknown remains. The interpretation of observations of this type merit a cautious approach as the degree and type of bone response to various pathological conditions often overlap, particularly in infectious, metabolic and neoplastic disease.

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As often used in anthropology and medicine, "pathology" represents an abnormal change in the normal anatomy, radiology and histology of human and non-human cellular tissue structure. Pathological conditions and lesions in skeletal and dental remains should be thoroughly described, photographed and subject to differential diagnosis. Since many of these conditions may have multiple interpretations or etiologies (e.g., osteo-, rheumatoid, or septic arthritis) classification is not as important as the differential diagnosis. Common types of pathological conditions and lesions that may be diagnosed include:

- Chronic infectious disease (e.g., tuberculosis, osteomyelitis).
- Metabolic disorders (e.g., porotic hyperostosis, osteoporosis).
- Neoplastic diseases (e.g., tumors).
- Congenital anomalies (e.g., spina bifida).
- Vascular/circulatory (e.g. aneurysms).
- Degenerative joint disease (e.g., osteoarthritis).
- Calcified arterial plaque, cartilage, or other soft tissue.
- Autoimmune diseases (e.g., rheumatoid or psoriatic arthritis).
- Other chronic conditions.

Given changes in the standard of living, access to and advances in medical care and improved nutrition over the past 100 years, many chronic and acute conditions that once affected the skeleton are now rare in countries with access to advanced medical care. Accordingly, the presence of some conditions (e.g., chronic osteomyelitis) may be of value in differentiating more modern forensic cases from ancient remains or discerning remains from developed regions from those in developing areas where antibiotic treatment was inaccessible or unavailable.

Definitive statements on the diagnosis of pathological conditions and lesions should be compared with documented clinical and forensic case studies that provide sufficiently detailed observations from relevant peer-reviewed anthropological, medical and related literature. The criteria used by the analyst should be documented in any reports submitted and the record of observations maintained in the case file to include radiological, microscopic and other special studies.

Identification should only be as specific as can reasonably be determined by a careful differential diagnosis. Infectious, metabolic, neoplastic and other complex designations often must meet demonstrable imaging criteria whereas biomechanically-related changes to bone originating from degenerative joint disease and trauma may only require macroscopic observations to be performed. In complex cases, a description of observed conditions and their distribution throughout the skeleton without the use of diagnostic terminology might be sufficient to assist in narrowing the diagnostic profile for an unidentified decedent.

Anomalies are uncommon conditions that exist in the skeleton and dentition and are usually congenital or epigenetic in origin. Examples include:

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- Accessory bones (e.g., wormian bones, *os japonicum*).
- Bipartite bones (e.g., bipartite patella).
- Sternal, septal, and other apertures.
- Bifid and/or supernumerary ribs.
- Vertebral shifts and other axial anomalies.
- Prominent features (e.g., everted gonion, bilobed chin, unusually large or small facial features).
- Cranial asymmetry.
- Cultural modifications.
- Premature closure of cranial sutures (note: isolated localized closure may be traumatic in origin).
- Premature ossification of cartilage.
- Supernumerary teeth, extra roots, fused teeth, dental agenesis, etc.
- Polydactyly.

Anomalies provide good circumstantial evidence toward identification provided clinical literature and peer-reviewed research can demonstrate how “anomalous” they are. Generally, the less common a trait, the more value it has toward identification.

As the term "anomalies" suggests, these traits can be distinctive to the individual or exist in low frequencies in populations. Uncommon traits found within osseous and dental remains have a great potential to contribute to the identification of the decedent. Recognition of these traits, and thus their usefulness in the identification process, is contingent on the overall completeness and preservation of the evidence.

Two criteria must first be met to make a pathological condition or anomaly potentially useful for identification purposes. First is its relative prevalence in a population. The more uncommon the pathological condition or anomaly the more potential it may have in contributing to identification. Unfortunately, the frequencies of different pathological conditions or anomalies are typically not adequately documented in the clinical literature, or are described only for living individuals whose skeletons may or may not have been affected by the disease. Second is the relative likelihood of a trait being recognized *in vivo* and subsequently documented. Uncommon skeletal traits without a corroborating antemortem record are merely points of academic interest.

Because the subject of pathological conditions, lesions and anomalies is diverse and complex, a comprehensive and specific discussion of methods and literature is beyond the scope of these guidelines. Rather, the anthropologist working within this area is expected to consult the relevant literature, much of it clinically based, in accordance with the observations at hand.

The following is designed to provide anthropologists with broad guidance on the process for recognizing, documenting, and using traits of individuation in the identification process and represents a synthesis of material presented in the anthropology and

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paleopathology literature. See, also, Section 6 below.

4.0 Best Practices

Anthropologists should thoroughly record and document all observations of pathological conditions, lesions and anomalies. Diagrams, sketches, photographs (and other imaging modalities), supplemented with written bench notes, are best used to describe pathological conditions, lesions and anomalies.

- Supporting documentation, such as radiographs, should be included with the technical notes and stored in a secure location.
- Where tests involve new or unpublished statistical models or procedures, these should be fully described. Any deviations from laboratory procedures should also be noted.

4.1 Comparisons and Identifications

Whenever pathological conditions, lesions or anomalies are identified, they should ultimately be compared with available antemortem medical records and the results included in the notes and the final report. Be cautious in excluding individuals simply due to the absence of the observed condition in the medical record. Skeletal conditions as observed and documented by the forensic anthropologist in the postmortem interval may have been subclinical in nature and/or asymptomatic and therefore undocumented at the time of death or when the medical record was prepared. Conversely, if the medical records document a pathological condition in the skeleton (such as a fracture or anomaly) and no such condition can be found upon examination, this may serve as the basis for exclusion. Every effort should be made to verify the medical records when there is conflicting information in a case with a presumed identification. The type of antemortem record available dictates the usefulness of the individuation traits for identification. Specifically:

4.2 Charts and Treatment Records

These are usually written or typed summaries of medical problems and treatments. They tend to be generalized and lack any great detail (e.g., a rib fracture). Consequently, the nature of these records relegates corresponding traits of individuation to circumstantial evidence only.

4.3 Radiographic Images

In principle, radiographic images of pathological and anomalous skeletal conditions and lesions provide individuation in sufficient detail to make a positive identification in the same manner as dental radiography. Because of pre-existing antemortem protocols, postmortem radiographs can usually be prepared in near identical orientation of the

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former. Comparisons can then be made with the radiographs juxta- or superimposed.

Typical areas used for comparison include, but are not limited to:

- Trabecular lattice patterns within individual bones or regions of bones.
- Distinctive areas of bone lucency and density.
- Cranial sinus shapes and patterns.
- Pathological features (e.g. exostoses, fused elements), keeping in mind that some features may change over the course of a lifetime.
- Size, location, and contours of features (e.g. spines, processes, tubercles, sutures, foramina).

As with dental radiography, no predefined number of points of concordance is currently required in order to make an identification. Rather, an identification depends on the overall number of points of concordance in conjunction with how distinctive they are. Additionally, the ability to exclude all other potential individuals of interest also supports this effort at individuation.

5.0 Unacceptable Practices

The following practices are considered unacceptable when identifying and describing pathological conditions, lesions and anomalies:

- Documenting a pseudopathology as a pathological condition. A pseudopathology represents a bony change that may mimic and be mistaken for an actual pathological condition or lesion during the process of differential diagnosis; it should be described and photographed and clearly distinguished from a *bona fide* condition. For example, taphonomic alterations like rodent gnawing or insect damage are sometimes mistaken for pathological conditions and lesions on bones.
- Accepting or reporting unsupported results, over-reaching in interpretation or too narrowly interpreting restrictive data.

6.0 Additional Considerations

Many classifications exist for documenting pathological conditions, lesions and anomalies in human remains. Since the anthropologist focuses most often on individual identifications, the formal classification of pathological and anomalous conditions and occupational markers at the population level becomes less critical. The following section offers guidance and methodology for developing a differential diagnosis from skeletal and dental remains.

6.1 Occupational Markers (Stress and Strain).

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Stresses and strain on an area of the skeleton over time may cause the skeleton to adapt to better withstand these forces. The most common indicators of these types of changes are occupational markers.

Occupational markers represent the cumulative effects on bone from repetitive activity over time (e.g., from occupational or recreational activity) that may alter the skeleton in the form of hyper-developed tubercles, crests, processes, and fossae, bowing or other changes in the diaphyses, facets, degenerative changes, or lesions. Often, in paired bones, asymmetry in robusticity, length, shape, and density may be indicative of such activity. Exaggerated signs of handedness (right or left) may in themselves be an occupational marker. Overexposure to some chemicals may leave marks on bone (e.g., spurring at the entheses [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.

6.2 Description and Differential Diagnosis

It should be understood that differential diagnosis is a process and not an outcome or result. The process allows the analyst to include and exclude possibilities as the process progresses. Depending on the nature of the remains (e.g., completeness, preservation, etc.) not all steps in the above differential diagnosis process may be feasible and/or they may only progress to a certain stage in the process.

As such, a definitive conclusion or diagnosis may not be forthcoming and equivocal results should be reported as such. All reasonable interpretations should be presented (e.g., “... given the remains present, the advanced nasal destruction could be a manifestation of tertiary yaws, advanced syphilis, or leprosy”). Upon recognition of an anomaly, occupational marker, or pathological lesion/condition, the anthropologist should describe and attempt to identify what is observed using the process of differential diagnosis.

Differential diagnosis may be straightforward and uncomplicated (e.g., recognition of a healed Colles’ fracture) or be relatively involved (e.g., determining the type of treponemal disease present). Regardless, description and documentation is the most important step in the differential diagnosis. The observations should be completely described and documented using a combination of text, photographs, diagrams, radiographs and sketches. Other anthropologists should be able to visualize the condition on the bone based on the written description from the notes.

The following process is a recommended guide to conducting differential diagnosis. Additional protocols, described below, may supplement this process.

- Describe the alteration using clear language. Avoid using terminology that has differing or ambiguous meanings in clinical, pathological, or anthropological literature. For example, lesions can be described or classified as lytic, proliferative, or deformative (destroying, depositing, or deforming bone,

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respectively). Other items to consider in descriptions of alterations include:

- Overall shape and size.
 - Extent of the bone involved (describe anatomically, e.g., distal third of shaft).
 - Distribution on the bone (discrete, multifocal, diffuse, circumferential, etc.).
 - Characteristics of the edges, walls and floor (blunt, sharp, regular, irregular, etc.).
 - Type of proliferative bone (compact, pitted, porous, loosely woven), if present.
 - Remodeling of bone.
 - Extent and progress of healing, if present.
 - Presence of accompanying features (cloacae, sequestra, periostitis).
 - If the bone is damaged, where possible, describe the condition of the bone layers in cross section.
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- Describe the condition of the remainder of the bone including the articular surface (e.g., eburnation on an adjacent articular surface).
 - Describe the adjacent bones (e.g., infection spread from the radial shaft to the interosseous crest of the ulna), to include articular surfaces.
 - Compare the altered bone to its antimere, if paired (note atrophy, deformation, rarification, thickening, etc.).
 - Describe other related pathological conditions in the remainder of the skeleton. Some conditions (e.g., treponemal) are diagnosed based on overall lesion distribution patterns in the skeleton.
 - Describe the distribution of similar conditions in the population. This is not directly feasible since the laboratory usually does not work on large population samples. However, clinical literature can be consulted as to frequencies in various populations. If two or more conditions are suspected, one common, the other rare, for an individual from a particular population group, the former is most likely.
 - Keep in mind that an individual may have more than one condition. If there are ambiguous or conflicting criteria, they may represent two or more pathological conditions.
 - Conduct appropriate research. Research may involve accessing clinical literature. Research is important since many alternative diagnoses may not be obvious