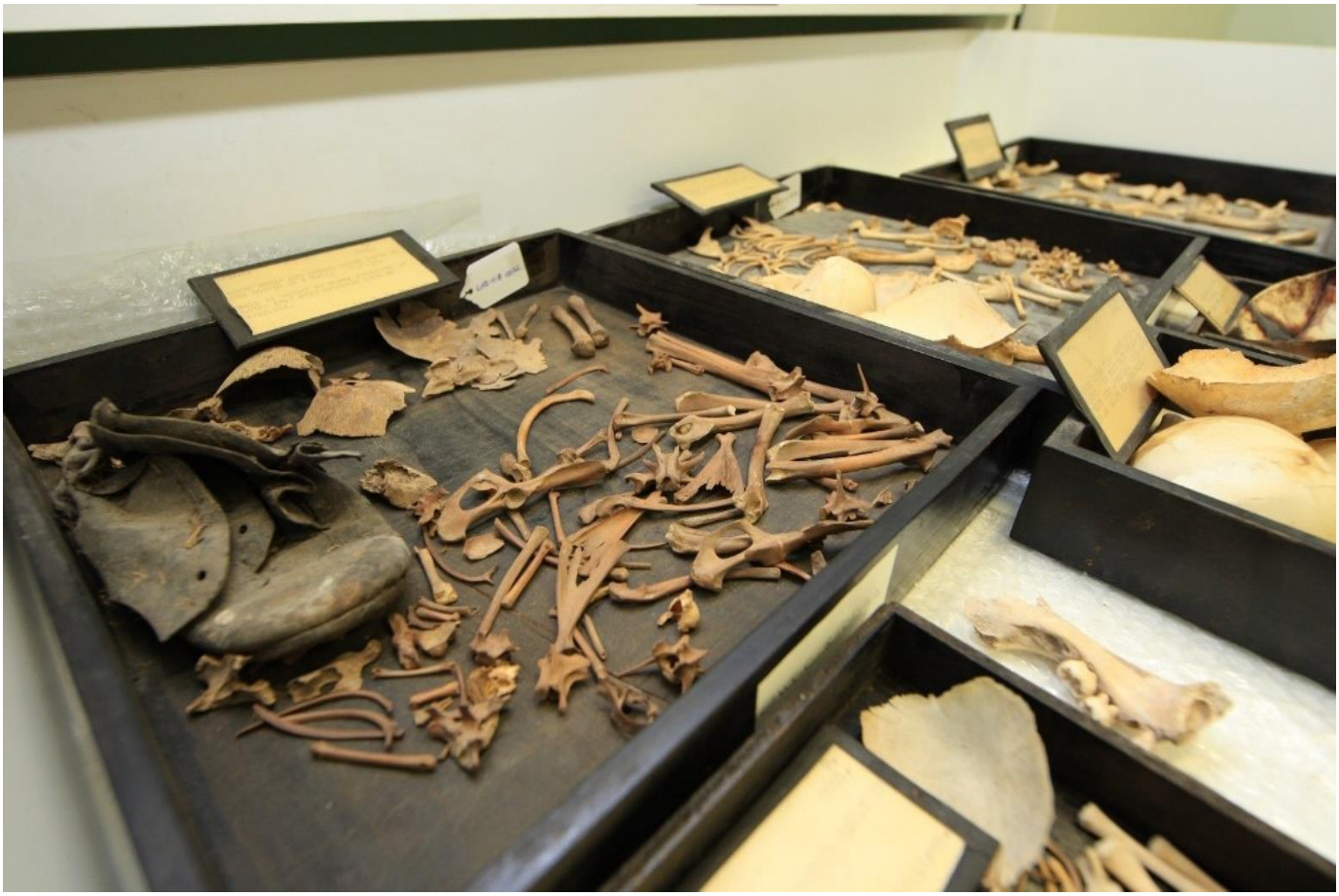
Medical Sciences
Specialist Advisory Group



Guidelines for Forensic Anthropology Practitioners

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1. INTRODUCTION

The aim of this document is to provide a set of guidelines for practising forensic anthropologists in Australia, that is, individuals undertaking forensic anthropology casework for a government forensic service provider. The guidelines represent a minimum set of methodological and ethical standards for practitioners to follow to conduct examinations, produce reports and provide expert evidence in court. These standards have been agreed upon by members of the Forensic Anthropology Technical Advisory Group (TAG) (previously known as the Forensic Anthropology Scientific Working Group -FA- SWG); a sub-group of the Medical Science Scientific Advisory Group (SAG) of Australia. The current document replaces the previous guidelines issued in December 2009.

The guidelines define the purpose of the forensic anthropology examination process and the series of steps that must be followed from the time a forensic anthropologist is notified of involvement in a case until the presentation of findings, whether by report alone or through the provision of evidence in the court room.

These guidelines draw from the Code of Practice for Forensic Anthropology, Royal Anthropological Institute, British Association of Forensic Anthropology (Anon 2018), and the United States Scientific Working Group for Forensic Anthropology (SWGANTH) (Anon 2010; Anon 2011; Anon 2012; Anon 2013a, 2013b, 2013c, 2013d).

2. FORENSIC ANTHROPOLOGY DEFINED

Forensic anthropology is defined as the application of physical/biological anthropology knowledge and techniques to matters of medicolegal, or forensic significance. This usually involves the examination and analysis of skeletal remains in a laboratory or mortuary setting but may also include recovery and scene interpretation of buried remains and/or surface scatters.

Skeletal remains presented for examination by a forensic anthropologist may be differentially preserved, including (but not limited to) skeletonised, partially skeletonised, decomposed or incinerated. These remains may be physically examined, and/or may be examined through various digital tools such as computed tomography (CT) scans, radiographs or photographs.

A forensic anthropology examination may also involve the examination and interpretation of living humans for identification or other specific purposes such as biological age estimation.

3. CASES REQUIRING A FORENSIC ANTHROPOLOGIST

All cases involving partially, or fully skeletonised human remains; or where identification of the individual is undetermined, should be referred to a forensic anthropologist for a professional opinion.

4. DUTIES AND RESPONSIBILITIES OF THE FORENSIC ANTHROPOLOGIST

A forensic anthropologist should possess qualifications, training, experience and competence to provide a professional opinion on the remains, including, but not limited to:

- recording, interpreting and undertaking and/or aiding the recovery of human remains at a scene
- assessing whether the material is osseous (bone) or non-osseous
- assessing whether the material is of human or non-human origin
- assessing the condition and preservation of human skeletal remains, and any taphonomic alterations
- assessing whether the remains are of medico-legal significance
- establishing the minimum number of individuals present
- developing a biological profile (age-at-death, sex, stature and ancestry)
- assessing the presence of other personal traits
- assessing post-mortem taphonomic changes or modifications
- assessing and recording traumatic injuries and providing an opinion about the timing of the injuries (ante-mortem and/or peri-mortem injury)
- commenting on the post-mortem interval (time since death) where possible
- reconstructing fragmented bones
- assisting in Disaster Victim Identification which may include scene and/or mortuary attendance
- providing advice to investigators on the most appropriate methods of identification (for example, DNA, dental identification, fingerprint comparison, assessment of ante-mortem medical records, radiographs and /or medical implants).

Practitioners should be available to provide evidence in court in an unbiased manner for the prosecution and defence.

5. QUALIFICATIONS/EXPERIENCE REQUIRED TO PRACTICE

A practising, professional forensic anthropologist shall have:

- a relevant undergraduate degree (for example, in Science majoring in human anatomy or in Arts majoring in anthropology and archaeology)
- formal association with a recognised Australia New Zealand Forensic Executive Committee (ANZFEC) approved institute
- current casework experience.

A practising, professional forensic anthropologist should have:

- a doctoral degree in physical / biological anthropology or human anatomy;
- publications in relevant peer reviewed journals on the subject of physical/biological/forensic anthropology are also desirable.

6. CONSULTATION WITH OTHER EXPERTS

It is important for the forensic anthropologist to be aware of the need for expert consultation. The forensic anthropologist regularly works closely with other forensic experts, which typically include forensic pathologists, odontologists and radiologists. This type of consultation is necessary for optimal case examination. In some instances, a need may arise to consult further experts in related areas such as clinical medical specialties, entomology, archaeology, soil sciences, etc. This consultation will be done on a case by case basis.

7. COGNITIVE BIAS

Forensic anthropologists, like forensic pathologists and other medical specialties, are potentially vulnerable to cognitive bias in some aspects of their examinations, but in other aspects, cannot operate effectively without contextual information. Forensic anthropologists are potentially susceptible to cognitive bias when cases are discussed informally before examination and report writing, or when examinations are conducted jointly, and the interpretation is discussed informally prior to each examiner conducting further tests and writing their own report.

The risk of not having contextual information may result in evidence being misinterpreted. Where the forensic anthropologist has relied on contextual information, interpretations are to be reported conservatively and with appropriate caveats. The potential for confirmation or expectation bias can be somewhat mitigated by peer review. Practitioners should be aware of the risks of bias in their examination, including contextual bias, and, where appropriate, take steps to minimise these risks (see FA TAG Statement of Cognitive Bias[1]).

8. CONSIDERATION OF ETHICAL RESPONSIBILITIES

Practitioners should approach their examinations and analyses with professionalism, dignity and respect and in accordance with accepted practice (See FA TAG Statement of Ethics[2]).

9. THE ROLE OF THE FORENSIC ANTHROPOLOGIST

Practitioners should implement their examinations based on varying factors which will be particular to each case or analysis. One or several techniques may be applied in each situation. Where possible and when available, techniques which have been validated should be used.

[1] This document is not publicly available but can be provided on request.
[2] This document is not publicly available but can be provided on request.

9.1 SCENE ASSESSMENT / IN SITU REMAINS

Information about the location/environment where the remains were found enables the forensic anthropologist to generate hypotheses about the likely post-mortem interval; the position of the body at the time of deposition, and other taphonomic and environmental factors. Opinions are usually generated by differential diagnosis, which may support or refute the original hypotheses. The scene forms the context by which the findings are interpreted. The importance of the scene in forensic anthropology cannot be understated and has been shown to be a key factor in forming an opinion (Nakhaeizadeh et al. 2017).

At the same time, it is acknowledged that attendance at a scene, or the provision of information about the scene by others, may expose the forensic anthropologist to information which may influence future analyses/opinions (Nakhaeizadeh et al. 2014; 2017).

9.2 ASSESSMENT OF CONDITION AND PRESERVATION

Practitioners should ensure that the original condition of the remains is thoroughly recorded prior to processing (i.e., removing any extraneous material or tissue remnants and cleaning the bones). This would usually include photographing and describing the bones as they were first received and/or observed. Searching for and collecting trace evidence should also be considered and discussed with investigators/other practitioners. Once this has been recorded and collected, processing of the remains can occur (if deemed appropriate), followed by further examination and detailed analysis.

9.3 DISTINGUISHING OSSEOUS / DENTAL REMAINS FROM NON-OSSEOUS MATERIALS

Assessment of size, morphology, texture and pertinent anatomical landmarks is undertaken to differentiate bones and/or dentition from extraneous materials (for example, rock, wood, shell or some manufactured materials). Selection of techniques or the type of analysis required for this assessment may vary depending on the condition, and size of the specimen/s.

RECOMMENDED CLASSIFICATIONS FOR THE SEGREGATION OF OSSEOUS AND DENTAL REMAINS:

The remains ARE Osseous/Dental remains: The remains exhibit features that indicate the material is bone or teeth.

The remains ARE NOT Osseous/Dental remains: The material does not exhibit features associated with a biological material such as bones or teeth.

Inconclusive: It is not possible to make a determination based on the morphology or features of the materials. *In these instances, the default assumption should be that the materials are osseous/dental and appropriate procedures be followed until proven otherwise*.

The following techniques may be applied to distinguish osseous and dental remains from non-osseous materials:

- Visual Examination: A visual (gross) examination of osseous or dental remains which are large and/or relatively complete. This is appropriate when the remains display diagnostic features including osteological landmarks, the presence of trabecular bone and/or evidence of a vascular component. The visual examination can be conducted on the physical material or on a photograph of the remains, providing the photograph is of acceptable quality to allow for an accurate assessment.
- Microscopic Examination: A microscopic examination of osseous or dental remains which are small and/or fragmented. This may reveal features of cortical bone, trabecular bone, vascularisation or other cellular anatomy. It may also help to exclude non-osseous or dental remains from further consideration.
- Additional Techniques: These may require consultation with another specialist/discipline and can involve Scanning Electron Microscopy, X-ray fluorescence or other elemental techniques which reveal the specimen's elemental composition.

Contextual information is usually task irrelevant when undertaking these determinations; however, it should be made available to the forensic anthropologist upon request.

9.4 DISTINGUISHING HUMAN FROM NON-HUMAN REMAINS

Assessment of morphology (overall size and shape) and pertinent anatomical landmarks is undertaken to differentiate between human and non-human bones. Selection of techniques or the type of analysis required for this assessment may vary depending on the completeness of the elements to be examined.

RECOMMENDED CLASSIFICATIONS FOR THE DETERMINATION OF HUMAN/NON-HUMAN REMAINS:

Diagnostic of Human: The remains exhibit features that, when compared to human reference specimens, exclude other reasonable possibilities.

Diagnostic of Non-human: The remains exhibit features which match known non-human specimens to the exclusion of other reasonable possibilities.

Inconclusive: It is not possible to make a determination based on the morphology or features of the remains. *In most of these instances, the default assumption should be that the remains are human and appropriate procedures should be followed until proven otherwise. An exception to this would be cases with numerous fragmented remains which can't be identified as human or otherwise. In these instances, the context may provide supporting information on the likelihood of them being non-human.*

One or more of the following techniques may be applied to distinguish human from non-human remains:

- Visual Examination: A visual (gross) examination of osseous or dental remains which are large and/or relatively complete. This is appropriate when the remains display diagnostic features including osteological landmarks. The visual examination can be conducted on the physical remains or on a photograph of the remains, providing the photograph is of acceptable quality to allow for an accurate assessment.
- Microscopic examination: A microscopic (histological) examination to distinguish human from non-human remains can be used for remains which are fragmented and where a visual examination is not conclusive. This requires specialist expertise.
- Additional techniques: These may require consultation with another specialist/discipline and can involve protein radio immunoassay or genetic testing of nuclear or mitochondrial DNA. Imaging may also be of assistance in making a determination.
- Selection of techniques or the type of analysis required for this determination may vary depending on the specimens received, their size, and their condition. Visual examination is the most common technique, but others may also be used.

UNACCEPTABLE PRACTICES

The following practices are considered unacceptable and should be avoided when determining the human/non-human origin of osseous and dental remains:

- Making gross morphological determinations of human versus non-human without proper training and experience in human osteology, human variation and a familiarity with non-human skeletal remains (e.g., training, a comparative collection of relevant taxa, and/or necessary reference material).
- Making a human/non-human differentiation from inadequate photographs. Possible inadequacies would include absence of a scale, poor quality image, partially obscured items of interest, and/or a lack of distinguishing features shown in an image. This is not an exhaustive list: the suitability of each image should be assessed by the forensic anthropologist prior to making a determination.

Contextual information is usually task irrelevant when undertaking these determinations; however, it may be made available to the forensic anthropologist upon request.

Consultation with another specialist (zoologist, veterinarian) may be appropriate.

9.5 DETERMINING THE NUMBER OF INDIVIDUALS PRESENT / THE MINIMUM NUMBER OF INDIVIDUALS

In cases where the remains are commingled and/or fragmentary it may be necessary to determine how many individuals are present. Assessment of the number of individuals present or the minimum number of individuals is ascertained by the presence of replicated skeletal elements as well as variations in morphology, condition and preservation.

The minimum number of individuals (MNI) in any assemblage of bones is the minimum number of individuals necessary to account for all the elements in the assemblage. Assessment of the MNI is ascertained by identifying:

- replication of bones which will be apparent when laying-out the skeleton/skeletal remains
- inconsistencies in bone size, colour, age, sex or even ancestry indicators.

Contextual information from the scene (if available) may be of value when undertaking these determinations on fragmentary or incomplete remains.

9.6 DETERMINING WHETHER THE REMAINS ARE OF MEDICO-LEGAL SIGNIFICANCE

Not all human bones and teeth are of medico-legal significance. This is usually the case when they are from historic or archaeological contexts. Other remains which may be recent but have no coronial interest include trophy skulls; teaching/reference specimens; cadaver specimens; religious or ceremonial material, or inadvertently disturbed cemetery remains.

However, human remains may still be of medico-legal significance even in the absence of criminal investigations. The forensic anthropologist needs to be aware of the specific legislation for medico-legal significance (based on estimated time since death) for the jurisdiction in which they are operating.

The determination of medico-legal (forensic) significance is used to separate remains of historical or archaeological context from those requiring coronial or criminal investigation. The determination is based on an assessment of post-mortem interval (time since death) combined with associated circumstantial information/evidence. In the absence of sufficient information to enable a determination to be made, the default assumption is that the remains are of medico-legal significance. Appropriate procedures should be followed until this can be proven otherwise.

Within Australia, the majority of State and Territory legislation makes no specific mention of a defined time period that determines whether the remains are of medico-legal significance. Most practitioners make assumptions (which may be guided by the case investigator) that remains older than 50-70 years are of no medico-legal significance. The exception to this is the New South Wales (NSW) and Victorian (VIC) legislation which clearly defines a time period in which human remains are of medico-legal significance[3].

[3] NSW: a coroner does not have jurisdiction to investigate the death unless the death occurred within the last 100 years; if they are found to be non-human remains; or if the remains found have no connection with NSW - Section 13B & 13C, NSW Coroners Act, 1980.
VIC: A coroner may investigate a death that is or may be a reportable death if the death appears to have occurred within 100 years before the death was reported to a coroner (VIC Coroners ACT, 2008 (Part 4, Div 1, 14.1). All Aboriginal Heritage is managed under the Aboriginal Heritage Act 2006 (Vic).

The management of Ancestral Aboriginal remains of varying antiquity are managed under specific State and Territory Acts. For example, the legislation in both Queensland and Tasmania specifically outlines that remains believed to be ancient indigenous remains are of no medico-legal significance[4]. In Tasmania the Coroners Act 2017 Section 23 makes special provision for the investigation of remains that the coroner suspects may be Aboriginal remains [Section 23(2)].

RECOMMENDED CLASSIFICATIONS OF MEDICO-LEGAL SIGNIFICANCE

Remains are of Medico-legal significance: The remains and associated contextual evidence indicate that the skeletal remains are of forensic interest.

Remains are of no Medico-legal significance: The remains and associated contextual evidence appear to be of no forensic interest.

Inconclusive: The remains and associated contextual evidence lack sufficient information to make a definitive determination of medico-legal significance. In these instances, the default assumption should be that the remains are of medico-legal significance and appropriate procedures should be followed until proven otherwise.

The following techniques may be applied to estimate the medico-legal significance of human remains:

- Visual Examination: A visual (gross) examination of the remains including an assessment of the cultural, taphonomic and contextual indicators. These indicators may include: method of disposal; position of the body (e.g. the absence of a coffin; bone arrangements that indicate a secondary burial); associated surface finds (e.g., clothing, weapons, identity cards, etc.); the condition of bone (e.g., "greasy" or "green" bone compared to highly degraded, weathered bone); the presence or absence of burial artefacts; examination of the dentition for presence/absence and quality of restorations and assessment of dental attrition, and the presence of surgical or medical implants in or among the remains. The visual examination can be conducted on the physical remains or on a photograph of the remains, providing the photograph is of acceptable quality to allow for an accurate assessment.
- Additional techniques: In order to determine the age of skeletal remains it may be necessary to employ a scientific dating technique such as SEM/EDS, pRIA, radiocarbon or post-bomb C14 dating or histological analysis. These may require consultation with another specialist/discipline. The forensic anthropologist should decide whether the circumstances of the remains warrant calling in specialised expertise. Utilising specialised techniques such as these without proper equipment or requisite training should be avoided. Further, the value of the results of the analyses must be considered in light of the fact that these techniques are destructive.

Contextual information from the scene (if available) may sometimes be relevant when undertaking the determinations of medico-legal significance.

9.7 INTERPRETATION OF TAPHONOMIC PROCESSES

An understanding of taphonomic processes may assist with interpreting the post-mortem alterations (whether environmental, cultural or intentional) to the hard tissues and associated evidence. The forensic anthropologist will describe, document and interpret the general preservation and condition of the remains in terms of colour, surface texture, surface changes, shape changes, and odour. Where possible, post-mortem alterations should be differentiated from those occurring ante- or peri-mortem.

Interpretation and consideration of taphonomic processes requires an awareness of the scene context as well as associated recovered evidence.

[4] QLD: a coroner must stop investigating a death if the coroner's investigation shows that the remains are believed to be indigenous burial remains (Section 12(2), Queensland Coroners Act, 2003; and Section 23(1)). In this context, indigenous burial remains are defined as burial remains to which the Cultural Record (Landscapes Queensland and Queensland Estate) Act 1987, Section 3453 applies. There are also the Aboriginal Cultural Heritage Act 2003 (QLD) and the Torres Strait Islander Cultural Heritage Act 2003 (QLD) which afford Ancestral remains additional protection *in situ*.

Taphonomic analysis may be supplemented by other disciplines, such as archaeology, entomology, botany, or soil sciences. The forensic anthropologist should be aware of the recommended evidence collection and preservation procedures of these other disciplines, in the event that evidence is submitted for analysis at a later date.

TAPHONOMIC ALTERATIONS

Taphonomic alterations can be divided into abiotic, biotic, and anthropogenic agents and effects. The more common agents and effects are listed below, but note that it is not an exhaustive list, and other agents and effects may be encountered in specific cases.

- Abiotic agents and association effects include those caused by weathering (mechanical, fluvial, exposure etc.); thermal events, or chemical damage (causing erosion). Note that while some texts or guidelines may refer to thermal damage as trauma, this can also be a result of taphonomic changes.
- Biotic agents and associated effects include those caused by decomposition processes; animal scavenging, trampling or predation; aquatic vertebrates/invertebrates/coral etc.; insect/boring activity; plant root etching or destruction.
- Anthropogenic agents and associated effects include modifications or annotations (for example to trophy skulls); preparation of remains as anatomical specimens; funerary cremation; religious practices; deliberate mutilation; accidental damage done during recovery.

ESTIMATING THE POST-MORTEM INTERVAL/TIME SINCE DEATH

The forensic anthropologist may be asked to provide an estimate on the post-mortem interval (time since death) of human remains. Estimation of the post-mortem interval is problematic due to the potential for variation in a large number of extrinsic (e.g., environmental) and intrinsic (e.g., physical) factors. Information about the circumstances and the environment where the remains were located, are essential when conducting an estimation of the time since death. The forensic anthropologist may not be able to estimate a time since death due to any number of complex interactions between variables, as well as specific known or unknown factors of each case.

UNACCEPTABLE PRACTICES

When interpreting taphonomy and estimating the post-mortem interval, the following practices should be avoided:

- Using terms such as “trauma” and “injury” to describe taphonomic events/defects.
- Making unsupported statements that are interpretive rather than descriptive (for example, “gold” instead of “yellow coloured metal”).
- Interpreting taphonomic signatures outside of one’s area of forensic expertise.
- Estimating the post-mortem interval without consideration of the taphonomic context/depositional environment
- Reporting overly precise or unsupportable post-mortem interval estimates.

Contextual information from the scene (if available) may be relevant when undertaking the interpretation of taphonomic changes.

9.8 ANALYSIS OF SKELETAL TRAUMA

The interpretation of skeletal trauma may commence at the scene and continue in the laboratory or be confined to the laboratory.

Skeletal trauma interpretation involves differentiating ante-mortem injury/disease and post-mortem damage from peri-mortem injury.

The forensic anthropologist conducts a differential diagnosis to proffer opinions about the likely mechanism/s of trauma (blunt, sharp, projectile) whether there is poly trauma); the degree of force, and the minimum number of impacts. The process of skeletal trauma analysis allows the forensic anthropologist to include and exclude possibilities during the course of the examination.

Detailed descriptions of the condition and preservation of the remains are essential because such factors determine the extent to which an opinion can be formed. Published lists exist of taphonomic changes to the skeleton which could be misinterpreted as possible trauma (see for example Blau et al. 2018). If remains are incomplete or poorly preserved, for example, it may not be possible to form a definitive opinion. Equivocal results should be reported as such.

A thorough interpretation of skeletal trauma requires access to information about the environment in which the remains were found. This may be accompanied by additional information relating to the discovery, suspect/victim details or other seemingly task irrelevant information, which has the potential for contextual bias. It has been shown that more experienced anthropologists are less likely to be influenced by the case circumstances during trauma analysis (Nakhaeizadeh et al. 2014). In cases of medico-legal significance, trauma interpretation may be conducted jointly by the case forensic pathologist and anthropologist. This joint approach is likely to reduce the possibility of contextual bias, however, may also result in confirmation bias for either or both practitioners.

RECOMMENDED PROCESS FOR THE ANALYSIS OF SKELETAL TRAUMA

- Initial examinations should be made prior to processing remains (i.e., cleaning, removing soft tissue etc.). The forensic anthropologist should always be alert to the possibilities of sampling for trace evidence on the edges of defects prior to any cleaning/defleshing of bones (e.g., Delabarde et al. 2017).
- Examinations should be undertaken with suitable ambient and directed lighting, and supplemented with magnification, radiography, and microscopy (where appropriate).
- The case file/report should include clear descriptions and documentation of observations, using notes, photographs, diagrams, and imaging, such as radiographs and/or computed tomography (CT) scans.
- Observations should be recorded with reference to anatomical location, description and measurements (where deemed necessary).
- Physical reconstruction of fragmentary remains during trauma interpretation will be case-dependent. The decision is the professional judgement of the practitioner, to determine whether it would add value to the investigation (e.g., reconstruction may assist to better identify patterns of damage/injury). It should be stated in the report/case file of why a reconstruction was/was not undertaken.
- Skeletal trauma analysis should be undertaken in consultation with a forensic pathologist, especially if soft tissues are present. Consultation with other experts, for example clinical medical specialists, should also be considered.
- Interpretation of skeletal trauma may have relevance to understanding the circumstances around the death. Interpretations should be based on scientifically valid methods and principles. Distinction should be drawn between description and interpretation.
- Terminology used by the forensic anthropologist to describe and interpret skeletal defects may differ from similar terminology used by forensic pathologists, police or other practitioners.

TERMINOLOGY

- The term “defect” should be used to refer to any changes to the integrity of the skeletal structure before interpretation about whether the changes are due to preservation and condition or trauma.
- The term “damage” should be used to refer to any post-mortem/taphonomic alterations.
- The term “injury” should be used to refer to any ante-mortem changes to the skeleton, which would be identified through the presence of an active bone response/healing.
- The term “fracture” relates to trauma or injury sustained in the peri-mortem period, or occasionally in the ante-mortem period, for example, old or healed fracture.
- The term “break” relates to post-mortem damage.
- The use of the term “thermal trauma” or “heat related fractures” is discouraged. Thermal changes to bone should be described in terms of the damage caused to the bone (i.e. a taphonomic process).
- The use of the term “post-mortem trauma” is discouraged, “post-mortem damage” is preferred. For example, “there was no apparent evidence of skeletal trauma” “there was some evidence of post-mortem damage”.
- Report terminology should avoid subjective terms which may be considered inflammatory by the courts, such as victim, weapon, etc. Instead, use terms such as deceased (or decedent) and object, which are more objective.

INTERPRETING THE TIMING OF SKELETAL TRAUMA

It is important to acknowledge that the forensic anthropologist is recording/interpreting the hard tissue response to specific forces. Any description of "peri-mortem trauma" should include a definition of the term noting that the forensic anthropological definition of "peri-mortem" may differ from that used by other experts (for example, forensic pathologists).

The forensic anthropologist should be able to provide an opinion of whether the skeletal trauma occurred in the ante- or peri-mortem periods or whether it was post-mortem damage. However, it is not possible to provide a "typical" time interval to allow differentiation of peri-mortem versus post-mortem change. There are too many variables affecting the responses of the skeleton between the peri- and post-mortem periods.

Ante-mortem and peri-mortem skeletal trauma should be distinguished from damage caused post-mortem by using the terms injury/trauma for the former and damage/break for the latter. Post-mortem damage, while helpful for interpreting taphonomy, is not associated with the death event.

MECHANISM OF SKELETAL TRAUMA

The forensic anthropologist should be able to provide a determination of the mechanism/s that caused the skeletal trauma. The mechanism is related to the various forces commonly associated with trauma.

The following terminology is preferred when reporting categories or types of mechanisms of trauma: sharp force; blunt force, projectile (high or low velocity).

Specific information about the different mechanisms of trauma is outlined below.

1. Projectile trauma
    1.1. Characterised by high velocity force/s (ballistic, shrapnel, crossbow etc.), but can include low velocity force as well.
    1.2. Not normally possible to ascertain range from the skeleton alone, unless under exceptional circumstances.
    1.3. Entry and exit points should be able to be ascertained, but may not always be apparent, there may be no exit point.
    1.4. Directionality may be difficult to ascertain in the absence of soft tissues.
    1.5. While the forensic anthropologist can provide a measurement of the defect's dimensions, identification of the bullet calibre based on this measurement is inappropriate.
    1.6. Velocity – may comment on high/low velocity (alternatively may also comment on rapid/slow impact).
2. Blunt force trauma
    2.1. Characterised by low velocity force/s (fall, assault, shock wave, vehicular accident).
    2.2. The use of the term "blow" is discouraged, "impact" is preferred.
    2.3. Degree of impact/force relates to the extent to which the bone is breached. Three levels of terminology may be used to describe this breach: mild, moderate or severe. However, this terminology is poorly defined (Blau et al. 2018).
    2.4. Nature of implement – only in exceptional circumstances. Individualization of a specific tool is unlikely.
    2.5. Directionality and point of impact are usually difficult to ascertain.
    2.6. Identifying where fractures terminate is important but may be difficult to ascertain in cases of multiple impacts or where complex fracture patterns are present.

3. Sharp force Trauma

    3.1. Characterised by low velocity forces.

    3.2. Injury is caused by edged, pointed or bevelled objects or tools. Injuries may be apparent as cut marks, chop marks, penetrating wounds, saw marks etc.

    3.3. The use of the term “stab” is discouraged, “penetrate” is preferred.

    3.4. The morphology of the bone affected by sharp force trauma can be described which may include the false start, kerf morphology, breakaway spur, striations, etc.

OTHER INFORMATION

If multiple impacts are present, the trauma can be categorised as “poly trauma”, and then elaborated in the report.

Each impact should be identified with a letter or number on documentation and photographs. Determination of the number of impacts, or sequencing of impacts, should only be done when it is obvious/unequivocal.

If it is possible to determine the direction of force, anatomical terminology should be used (superior, medial etc.).

If it is possible to estimate the amount or degree of force, the following terms are recommended: slight, moderate, severe. However, it is acknowledged that there is no evidence base to adequately define the meaning of these terms.

UNACCEPTABLE PRACTICES

When interpreting trauma, the following practices are considered unacceptable and should be avoided:

- Using terms such as “trauma” and “injury” to describe post-mortem defects.
- Making interpretive statements that are beyond the forensic expertise of the forensic anthropologist.
- Making unsupported statements that are interpretive rather than descriptive.

9.9 DEVELOPING A BIOLOGICAL PROFILE

The biological profile has traditionally been one of the key investigative roles of the forensic anthropologist. The information provided in the biological profile of each individual is normally used by investigators to include or exclude potential victims or missing persons from the investigation. In Australia, a positive identification is made by the State Coroner, based on information provided by Police and scientific reports. Information from a biological profile may be contributory to a positive identification but is not a primary identifier. Instead, the information is usually used to narrow down the list of potential subjects and verify the identification with a primary identifier such as dental, fingerprint or DNA comparisons.

The biological profile (estimation of ancestry, age, sex and stature) is usually developed in the initial stages of an examination of human skeletal remains. The aim of a biological profile is to assist investigators in cases of medico-legal significance to focus their efforts in confirming the identity of the remains. Information about the personal effects located with skeletal remains has been shown to influence laboratory analyses regarding the determination of sex for some investigators (e.g., Nakhaeizadeh et al. 2017). The actual effect of this contextual information on practitioners is unclear, as the participants in the study were students working on mock cases rather than practitioners. Despite this limitation, the forensic anthropologist should be aware of the bias that could result in an individual or group of individuals being excluded as the possible victim/s or missing person.

A biological profile alone would not normally be required for court (forensic) purposes, as the deceased is usually positively identified by the time the matter is before the courts. However, a biological profile should be included in the forensic anthropology report as at the time of preparation it is not always known whether not the report will be submitted to court. This can be crucial in reports relating to unidentified human remains cases (long term missing persons).

These guidelines are not intended to endorse any one particular method but promote a reliable and objective approach which should result in a valid assessment of a biological profile. The methods selected should be scientifically tested and validated, and any limitations of the method made clear. Efforts should be made to avoid bias or subjective interpretation.

9.9.1 ESTIMATING THE ANCESTRY OF THE INDIVIDUAL

Estimation of ancestry may be used to narrow the list of potential subjects. Ancestry estimation may also affect estimates of other aspects of the biological profile. Skeletal morphology, while variable as a result of environmental factors, is also highly heritable, and can be used to assess population relationships. Methods attempt to maximise between-group differences (variation) to classify an individual skeleton as belonging to, or originating from, a particular population group. There are no clear-cut indicators or a distinctive single trait that uniquely identifies any human group. Trait frequencies and measurement means are usually used to classify the individual as belonging to the most "typical" population group.

Ancestry estimation should be approached in a systematic manner. Many different methods are available, and some may be population specific. These guidelines are not intended to endorse any one particular method, but to promote a reliable and objective approach which should result in a valid assessment of ancestry.

Selection and application of methods will depend on the type and condition of the skeletal material available for examination. Ancestry assessments are usually only undertaken on adult remains because skeletal development is still occurring in children, and it is usually very difficult to determine their ancestry (however see 10.1.4 below for exceptions).

RECOMMENDED REPORTING FOR THE ASSESSMENT OF ANCESTRY ARE:

Typical of xxxx: The remains exhibit features that are typical of an individual of xxxxx ancestry.

Mixed ancestry: The remains exhibit features that are typical of xxxxx and yyyyyy ancestry, indicating possible mixed ancestry.

Undetermined: It is not possible to make an estimation of ancestry based on the morphology or features of the remains.

Assessment of ancestry can be undertaken using the following approaches (either singly or combined).

MORPHOLOGICAL ASSESSMENT OF ANCESTRY

Morphological assessment of ancestry involves assessing the presence or absence, or degree of development, of skeletal and dental morphological (non-metric) traits.

The skull (e.g., DiGangi and Hefner 2013; Hefner 2009; Hefner et al. 2012) and dentition (e.g., Scott et al. 2018) are typically the focus of analysis.

Although deemed less reliable, some attention in the literature has been given to population differences in post-cranial skeletal elements e.g., variation in bifidity of the cervical spinous processes (e.g., Duray et al. 1999); morphology of the inter-condylar shelf (e.g., Craig 1995), and curvature of the long bones (e.g., Stewart 1962, Trudell 1999).

When morphological traits are used to assess ancestry, the following should be considered: 1) appropriate reference groups; 2) clear trait descriptions; 3) appropriate statistical methods of classification.

Due to the limitations of the assessment of ancestry, the probability, or uncertainty, with which the ancestry is estimated should be ascertained and presented in the final report.

METRIC ASSESSMENT OF ANCESTRY

There are a number of cranial and post-cranial measurements that may be used to differentiate between populations.

Depending on the preservation of the remains, a series of cranial measurements are taken and entered into a computer package which provides an ancestry assessment with related likelihood percentages. Software packages that are more commonly used are CRANID (Wright 1992; 2008) and Fordisc (Jantz and Ousley 2005, Moore-Jansen et al. 1994).

When measurements are used to assess ancestry, the following should be considered: 1) appropriate reference groups; 2) clear measurement definitions; 3) appropriate methods of statistical classification.

Where appropriate, estimates of uncertainty should be included with any metric or statistical assessment.

ADDITIONAL TECHNIQUES FOR ESTIMATING ANCESTRY

In order to obtain further information about the ancestry or provenance of the deceased person it may be possible to conduct biomolecular or isotopic analyses and compare results with those of known population groups. These may require consultation with another specialist/discipline. Due to the destructive nature of the testing, as well as time and cost factors, they are typically a last resort. The forensic anthropologist should decide whether the circumstances of the remains warrant calling in specialised expertise in these areas.

CULTURAL INDICATORS PARTICULAR TO AUSTRALIA

The context of skeletal remains in Australia means that a considerable proportion of cases are found to be historic/archaeological remains of Australian Aboriginal people. Early identification or recognition of these skeletal remains as historic can preclude the need for more extensive testing/examination.

There are a number of cultural indicators that may indicate the remains to be of Aboriginal ancestry and of archaeological or historic time period (e.g., Byard and Simpson 2005; Oxenham et al. 2008). These include but are not limited to:

1. significant dental attrition in the occlusal plane
2. lack of caries in most individuals apart from those estimated to be of advanced age
3. the evulsion of front teeth (usually upper incisors) (an initiation rite practiced by some Australian Aboriginal groups)
4. the method of disposal (e.g. bundle and log burials)
5. ochre staining of the bones
6. mortuary disarticulation trauma of the bones
7. platycnemia and squatting facets
8. association with shell midden materials and animal remains used in burial feasts (e.g., dingo and fish bones)
9. association with stone artefacts, and/ or cached remains and / or bone implements and ornaments.

Assessment of ancestry should mainly be undertaken on adult remains because skeletal development is still occurring in children, and it is usually very difficult to determine their ancestry. However, the presence of dolichocephaly, phaenozygy and excessive dental attrition in juvenile skeletal remains may suggest an Australian Aboriginal origin.

9.9.2 ESTIMATING THE SEX OF THE INDIVIDUAL

Sexual dimorphism of the human skeleton does not develop until after puberty. Therefore, sex estimation of juvenile skeletal material based on morphological traits is notoriously unreliable and should not be attempted. If it is decided that knowing the sex of a juvenile skeleton is helpful to an investigation, consideration should be given to a molecular assessment of sex. If other approaches are used, the methodology selected should be included in the report.

Sex estimation should be approached in a systematic manner. The most appropriate technique/s should be applied. Many different methods are available, and some may be population specific.

Sex estimation is based on biological principles of sexual dimorphism (maleness and femaleness) and may be affected by factors including inter- and intra-population differences, age, pathology and taphonomy. All of these should be considered as possible contributors to variation when estimating sex.

RECOMMENDED CLASSIFICATIONS FOR SEX ESTIMATION

1. Undetermined: It is not possible to make an estimation based on the morphology or features of the skeletal elements present.
2. Female: There is little doubt that the skeletal remains represent a female.
3. Probable female: The skeletal remains are more likely female than male.
4. Ambiguous sex: Sexually diagnostic features are ambiguous.
5. Probable male: The skeletal remains are more likely male than female.
6. Male: There is little doubt that the skeletal remains represent a male.

There are two non-destructive approaches to estimating the sex of an adult from the skeleton. These involve the assessment of morphological features of the skeleton; and the use of metric criteria in the form of indices (ratios of measurements) and/or discriminant functions (uni- or multivariate statistics). Method selection and application may depend on the bones or skeletal elements present.

MORPHOLOGICAL ASSESSMENT OF SEX

Morphological methods of sex assessment involve examining skeletal remains for differences in the expression of a characteristic (shape) or presence/absence of features. The pelvis and skull are typically preferred as indicators of sexual dimorphism, with the pelvis showing greater dimorphism than the skull and post-cranial elements. If the pelvic bones are present and in good condition, the reliability of the assessment is greatly increased. If however, these skeletal elements are poorly preserved other skeletal elements may be examined but the reliability of the results decreases.

METRIC ASSESSMENT OF SEX

Metric methods of sex assessment involve measuring size/shape of skeletal elements. A number of skeletal measurements can be taken that are indicative of the sex of an individual. Most of these involve lengths of limb bones, and sizes of articular surfaces. Measurements should be taken with appropriate osteometric instruments and/or software and compared to relevant data from the appropriate population. Multiple measurements will usually provide greater reliability than a single measurement.

UNACCEPTABLE PRACTICES

When estimating sex, the following practices are considered unacceptable and should be avoided:

1. Estimating sex of juvenile remains (under 12 years), and younger adolescents (>14 years) in general unless the pelvic elements are present and fused.
2. Reporting sex as ‘gender’.
3. Basing conclusions on methods that have not been validated.

9.9.3 ESTIMATING THE AGE OF THE INDIVIDUAL

Estimation of age by a forensic anthropologist is primarily used to estimate the age-at-death of skeletonised remains, however it may also be used to estimate the age of living individuals. The underlying principle of age estimation is to assess physiological (or biological age), and correlate it with chronological age. Physiological or biological age can be assessed by examining traits which have been observed and documented in modern individuals of known age, sex and ancestry. The correlations between chronological and physiological age are not perfect, and the strength of the correlation can vary between and across trait expressions.

The methods selected should be scientifically tested, and any limitations of the method made clear. Efforts should be made to avoid bias or subjective interpretation.

Acceptable traits for age estimation must meet the following criteria: observed changes are uni-directional with age; traits are highly correlated with chronological age; changes occur roughly at the same age in all individuals (at least within a distinguishable sub-group).

Selection of methods for age estimation depends on the preservation and condition of the remains available for examination; and the age category of the individual. Population- and sex-specific variations or limitations should also be considered. Age estimation of foetal, infant, child, adolescent and adult skeletal remains may involve differing methods or applications, including visual examination, radiography, and histology.

Examination of the skeletal and/or dental remains provides a more accurate age for younger, as opposed to older, individuals. In most cases age estimates should be presented as belonging to one of the following categories, with each category having different precision.

- Foetus: 8 weeks- birth
- Infant: 0-<2 years
- Child: 2-<13 years
- Adolescent: 13-<18 years

} Juvenile (sub-adult)

- Young adult: 18-35 years
- Middle adult: 36-50 years
- Old adult: 50+ years

} Adult

ESTIMATING THE AGE OF JUVENILES: DEVELOPMENTAL TRAITS

When estimating the age of a sub-adult, the following should be kept in mind:

Age assessment using dental development (assessed radiographically) is more reliable than dental eruption, as the timing and sequence of eruption can vary between individuals.

Age assessment using dental development is more reliable than epiphyseal appearance and union.

Females usually mature earlier (both skeletally and dentally) than males. Some population differences in the extent and nature of these differences are present.

Epiphyseal union is more reliable than the appearance of growth centres. The timing and sequence of epiphyseal union varies between individuals. The degree of closure of epiphyses should be assessed, as closure can take several years in some instances.

The age of a juvenile may be determined using one or a combination of the following:

1. dental calcification and eruption
2. length of long bones
3. epiphyseal ossification and union
4. cranial synchondroses.

Standard references include Kosa (1989); Scheuer et al. (1980); Scheuer & Black (2000).

In addition to the characteristics noted above, a number of skeletal elements may be examined to determine the age of young adults. These include, but are not limited to:

1. iliac crest
2. annular rings of the vertebral bodies
3. jugular growth plate (petroexoccipital articulation)

4. medial clavicle
5. spheno-occipital synchondrosis
6. sacral vertebral body fusion.

ESTIMATING THE AGE OF MATURE ADULTS: DEGENERATIVE TRAITS

Age estimation in mature adults is more difficult and much less accurate than in growing children and adolescents. Most age estimates are based on degenerative traits that occur in joint surfaces, bones and cartilage.

A number of skeletal elements may be examined to estimate the age of mid-older adults. These include:

1. pubic symphysis (e.g., Brooks and Suchey 1990)
2. auricular surface (e.g., Lovejoy et al. 1985)
3. sternal rib ends (e.g., Iscan et al. 1984; 1985)
4. cranial suture closure (e.g., Meindl and Lovejoy 1985; Mann et al. 1987)
5. the development of vertebral arthritis (S e.g., tewart 1958; Winburn and Stock 2019)
6. ossification of laryngeal structures (e.g., Garvin 2008)
7. other changes to bone structure.

In cases of fragmentary or incomplete skeletal remains, assessment of the histomorphometry of cortical bone samples from long bone shafts (e.g. femur, tibia, humerus etc.) or from the mandible may be used (Kerley 1965 & the revisions of Kerley & Ubelaker 1978). This technique requires specialist knowledge and experience.

Given the difficulties associated with estimating the age of mature adults, final age estimation should be provided in ranges (see above).

UNACCEPTABLE PRACTICES

When estimating age, the following practices are considered unacceptable and should be avoided:

1. Reporting overly precise age estimates (without proper documentation of the variation/error involved).
2. Reporting age estimations without giving proper attention to sex/population factors.
3. Basing conclusions on methods that have not been validated.

9.9.4 ESTIMATING THE STATURE OF THE INDIVIDUAL

Stature is estimated using measurements taken from long bones. Most commonly, stature may be estimated by either measuring the length of a single, complete, bone and applying a regression equation, or adding measurements of all the bones which contribute to the total stature of an individual and adjusting for absent soft tissue. In some instances, it may be appropriate to include measurements of incomplete (e.g., Steele and McKern 1969; Steele 1970) or reconstructed limb bones, non-limb bones, or alternative statistical methods.

In all instances the condition and preservation of the long bones should be assessed in addition to the sex, ancestry and temporal period. Depending on the skeletal elements and the ancestry of the remains, a specific regression equation is employed to determine stature. Specific equations include those for:

1. Caucasoid males and females (e.g., Ousley 1995)
2. Negroid (African) males and females; also used for Aboriginal Australians (e.g., Ousley 1995) but the error margin is increased when the Negroid equations are used for Australian Aborigines
3. Aboriginal Australians (e.g., Makintosh 1952; Pretty et al. 1998)
4. Mongoloid (Asian) males and females (e.g., Trotter and Gleser 1958)

5. unknown ancestry (e.g., Dupertuis and Hadden 1951).

Stature results are presented either in millimetres or centimetres; or feet and inches, with an error margin derived from the relevant literature or statistical likelihood calculations.

Stature may be calculated using software (e.g., Fordisc 3.1).

In cases of elderly individuals, corrections must be made to the estimate due to the reduction in stature associated with the ageing and degeneration of the vertebral column (Galloway 1988).

Estimation of stature of sub-adults should be done with caution, as limited research has been done is this area.

UNACCEPTABLE PRACTICES

When estimating stature, the following practices are considered unacceptable and should be avoided:

1. The use of Trotter's formulae using tibia without making proper adjustments (in the original publication, the medial malleolus was apparently excluded from measurements of the tibiae) (Trotter and Gleser 1952, Trotter 1970).
2. Reporting a point estimation alone when the regression approach is used. Include an explicit prediction interval.
3. Reporting a range for a stature estimation based on a regression formula. "Interval" is a more appropriate term, as "range" typically designates the difference between a variable's minimum and maximum values.
4. Averaging multiple stature estimations to produce a single estimate. The formula with the smallest standard error should be reported.
5. Using the mean bone length in a whole bone stature regression formula when estimating stature from a fragmentary bone length, without including the additional error estimate.

9.9.5 SKELETAL VARIATIONS, PATHOLOGICAL CONDITIONS, LESIONS AND ANOMALIES

Cranial and post-cranial variations, pathological conditions, lesions and anomalies may prove valuable in individuation, life history, and/or the circumstances around the death.

The examination should be performed in a manner that enables a differential diagnosis to be made, as well as documentation, replication and verification of the work performed. Interpretation of pathological conditions, lesions and anomalies requires a cautious approach.

If a differential diagnosis cannot be made, detailed documentation may be sufficient to describe the location and distribution throughout the skeleton and the physical manifestation. This includes descriptions and photographs of:

1. position in relation to anatomical landmarks
2. abnormality of shape
3. abnormality of size: bone loss, bone formation.

In addition to macroscopic inspection, imaging, histology and microscopy should be used where appropriate.

The forensic anthropologist should decide whether the circumstances of the remains warrant calling in specialised expertise in these areas. Consultation with clinical texts, other experts and/or clinicians should be considered.

Pathological conditions and lesions represent an abnormal change to the normal anatomy, often the result of a disease. This may be apparent grossly, radiographically or histologically. Common types include infectious diseases, metabolic disorders, neoplastic diseases, congenital abnormalities, vascular/circulatory pathologies, degenerative joint diseases, calcified soft tissue or arterial plaque, autoimmune disease, trauma (healed or healing lesions).

Anomalies are recognised skeletal abnormalities or malformations and are usually congenital. Common types include accessory bones, bipartite bones, apertures, bifid or supernumerary ribs, vertebral shifts, prominent features, cranial asymmetry, dental anomalies and polydactyly.

ADDITIONAL CONSIDERATIONS

Instances of pseudopathology (taphonomic processes which mimic pathological conditions or lesions) should be considered, and if present, described and distinguished from other conditions.

Instances of cultural taphonomic processes or modifications should be considered, and if present, described and distinguished from other conditions.

Secular, temporal and geographical aspects should also be considered when interpreting pathological conditions, lesions and anomalies.

Occupational markers should be considered when describing pathological conditions, lesions, skeletal variants and anomalies.

UNACCEPTABLE PRACTICES

When identifying and describing pathological conditions, lesions and anomalies, the following practices are considered unacceptable and should be avoided:

1. Reporting unsupportable results, over-reaching in interpretation, or too narrowly interpreting observations.
2. Reaching a differential diagnosis with inadequate descriptions or documentation.
3. Reaching an immediate conclusion without undertaking a differential diagnosis.
4. Failing to employ imaging modalities when appropriate.

NON-METRIC TRAITS

The following is a list of normal traits or variants in the skeleton which could mimic and possibly be misinterpreted as trauma. Further information may be found in the following texts: Barnes 2012; Berry and Berry 1967; Finnegan 1977; Hauser and De Stephano 1989.

CRANIAL

- Sutural variations
- Metopic suture - incomplete and fissure
- Bipartite parietal bone – may be complete or incomplete
- Bipartite temporal squama bone
- Squamomastoid suture
- Squamous foramina in temporal bone
- Epipteric bones
- Incomplete inca bones
- Missing ossicle in suture
- Supraorbital grooves
- Supraorbital notch
- Enlarged foramina – e.g. nasal and parietal foramina
- Bridging in foramina on base of cranium.

POSTCRANIAL

- Vertebrae – incomplete posterior and lateral bridging
- Cervical vertebrae – incomplete transverse foramen
- Spina bifida of C1 or sacrum
- Sternal aperture
- Sternal cleft
- Septal aperture
- Supra scapula foramen
- Femur - Allens Fossa
- Clavicle – costoclavicular sulcus
- Bipartite patella
- Vastus notch on patella.

10. LABORATORY DOCUMENTATION REPORTS

Laboratory documentation and reports should be prepared in a systematic and organised manner.

Documentation may exist in the form of hard copy, electronic, digital, analogue, photographic, or written.

Documentation may exist in the following formats:

1. Forms (a designated data or information collection medium)
2. Records (technical notes, completed forms, reports).

Technical notes (a type of record) are usually created during an examination. They may consist of field or laboratory notes; diagrams; charts; photographs that form the basis for analysis/technical conclusions; computer print-outs produced or used in the course of testing; non-rewritable CDs; copies of medical or dental records; other documentation used as a basis for analysis or technical conclusions.

Laboratory documentation should include a case identifier, signature or initials of the practitioner, and a date/s of examination on each page. The number of pages should be noted in a way which shows which page of the document is present and the total number of pages (for example, 1 of 2, 2 of 2).

Records retained should contain enough information for the test/s or examination/s to be repeated under similar conditions to the original, and such that another anthropologist could evaluate what was done and interpret the data.

The case report should include results of examinations or tests carried out. Results should be reported accurately, clearly, unambiguously, objectively, and in accordance with any specific instructions of the method. The report should include all information necessary for the interpretation of the results.

As a minimum, the following is recommended for inclusion in a report, or, if not in the report, then included elsewhere in the case file:

1. Title
2. Laboratory name and address
3. Location where the examination/s were conducted
4. Case number/identifier (on each page)

5. Page number on each page as well as the total number of pages (1 of 2 etc.)
6. Methods used in the examination
7. Description of items examined
8. Date items were received
9. Results or conclusions of the examination
10. Signature, name and function/role of the examiner/s writing the report (usually the case anthropologist).

Report content should be organised according to the examinations conducted (as appropriate to each case), and include sections on (for example) condition/preservation of remains, minimum number of individuals, biological profile, ante-mortem injuries or pathologies, analysis of trauma, etc.

Opinions and interpretations should be identified as such in the report and be distinguishable from descriptions.

If relevant to the methods used, the significance of a result or confidence intervals should be reported.

If results are undetermined or inconclusive, the reasons should be included in the report.

If a method has been varied, or other deviations made, this should be included in the report.

Limitations to examinations or results should be commented on.

Uncertainty of measurement of results should be commented on if it is relevant to the validity or interpretation of results.

Supplementary or replacement reports should be identified as such and include a reference to the original report to which it pertains.

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ANZPAA NIFS is responsible for the management and co-ordination of the Specialist Advisory Groups and has reporting accountability to the Australia New Zealand Forensic Executive Committee (ANZFEC).

The Technical Advisory Group members involved in the preparation of this report were:

- Soren Blau (Victorian Institute of Forensic Medicine)
- Alanah Buck (PathWest)
- Denise Donlon (University of Sydney/ Department of Forensic Medicine, NSW)
- Ellie Simpson (Forensic Science South Australia)
- Anne-Marie Williams (The University of Tasmania/Department of Health and Human Services TAS)
- Donna MacGregor (Griffith University/ Queensland Police).

12.REFERENCES

1. Anon. 2018. Code of Practice for Forensic Anthropology. Royal Anthropological Institute. https://www.gov.uk/government/publications/forensic-anthropology-code-of-practice (Accessed 05/08/19).
2. Anon. 2010. Sex Assessment. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_sex_assessment.pdf (accessed 5/11/2019).
3. Anon. 2011. Trauma Analysis. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_trauma.pdf (accessed 05/11/2019).
4. Anon. 2012. Stature Estimation. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_stature_estimation.pdf (accessed 07/08/19).
5. Anon. 2013a. Determination of Medicolegal Significance from Suspected Osseous and Dental Remains. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_determination_of_medicolegal_significance.pdf (accessed 5/11/2019).
6. Anon. 2013b. Ancestry Assessment. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_ancestry_assessment.pdf (accessed 5/11/2019).
7. Anon. 2013c. Age Estimation. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_age_estimation.pdf (accessed 5/11/2019).
8. Anon. 2013d. Taphonomic Observations in the Postmortem Interval. Scientific Working Group for Forensic Anthropology (SWGANTH). https://www.nist.gov/system/files/documents/2018/03/13/swganth_taphonomic_observations.pdf (accessed 5/11/2019).
9. Barnes, E. 2012. Atlas of Developmental Field Anomalies of the Human Skeleton. London: John Wiley & Sons, Inc.
10. Berry, AC., Berry, RJ. 1967. Epigenetic variation in the human cranium. Journal of Anatomy 101: 361-379.
11. Blau, S., Ranson, D., O'Donnell, C. 2018. Atlas of Skeletal Trauma in Medico-Legal Contexts. London: Elsevier:
12. Brooks, S, Suchey, JM. 1990. Skeletal age determination based on the os pubis: A comparison of the Ascadi-Nemeskeri and Suchey- Brooks methods. Human Evolution 5: 227-238.
13. Byard, RW., Simpson, E. 2005. Characteristic acquired features of Indigenous Australians that may be observed in forensic practice. Forensic Science, Medicine, and Pathology 1: 207-213.
14. Craig, EA. 1995. Intercondylar shelf angle: a new method to determine race from the distal femur. Journal of Forensic Sciences: 40: 777-82.
15. Delabarde, T, Cannet, C, Raul, JS, Géraut, A, Taccoen, M, Ludes, B. 2017. Bone and soft tissue histology: a new approach to determine characteristics of offending instrument in sharp force injuries. International Journal of Legal Medicine 131: 1313-1323.

16. DiGangi, E.A., Hefner, J.T. 2013. Ancestry estimation. In: DiGangi,E.A and Moore, M.K (Eds.) Research Methods in Human Skeletal Biology. pp. 117-149: London: Academic Press.

17. Dupertuis, CW, Hadden JA. 1951. On the reconstruction of stature from long bones. American Journal of Physical Anthropology 9: 15-53.

18. Duray, SM, Morter, HB, Smith, FJ. 1999 Morphological variation in cervical spinous processes: Potential applications in the forensic identification of race from the skeleton. Journal of Forensic Sciences: 44: 937-44.

19. Finnegen, M. 1978. Non-metric variation of the infracranial skeleton. Journal of Anatomy 125: 23-37.

20. Garvin, HM. 2008. Ossification of laryngeal structures as indicators of age. Journal of Forensic Sciences 53(5): 1023-1027.

21. Galloway, A. 1988. Estimation actual height in the older individual. Journal of Forensic Sciences 33: 126-136.

22. Hauser, G., De Stephano, G.F. 1989 Epigenetic variants of the human skull. Stuttgart: Schweizerbart.

23. Hefner, J.T. 2009. Cranial nonmetic variation and estimating ancestry. Journal of Forensic Sciences 54(5), 985-995.

24. Hefner, J.T., Ousley, S.D., Dirkmaat, D.C. 2012. Morphoscopic traits and the assessment of ancestry. In: Dirkmaat, D. (Ed.). A Companion to Forensic Anthropology. pp. 287-310. Hoboken, N.J.: Wiley-Blackwell.

25. Iscan, MY, Loth, SR, Wright, RK. 1984. Age Estimation from the rib by phase analysis: White males. Journal of Forensic Sciences 29: 1094-1104.

26. Iscan, MY, Loth, SR, Wright, RK. 1985. Age Estimation from the rib by phase analysis: White females. Journal of Forensic Sciences 30: 853-863.

27. Jantz, RL., Ousley, SD. 2005. Fordisc 3.1: Personal computer forensic discriminant functions. The University of Tennessee, Knoxville

28. Kerley, ER. 1965. The microscopic determination of age in human bone. American Journal of Physical Anthropology 23: 149-163

29. Kerley, ER, Ubelaker, DH. 1978. Revisions in the microscopic method of estimating age at death in human cortical bone. American journal of Physical Anthropology 49: 545-546.

30. Kosa, F. 1989. Age estimation from the fetal skeleton. In: Iscan, MY. (ed.). Age markers in the Human Skeleton. Springfield: Charles C Thomas, pp 21-54.

31. Lovejoy, CO, Meindl. RS, Pryzbeck, TR, Mensforth, RP. 1985. Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death. American Journal of Physical Anthropology 68: 15-28.

32. Makintosh, N. 1952. Stature in some Aboriginal tribes in southwest Arnhem Land. Oceania 22: 208-215.

33. Mann, RW; Symes, SA; Bass, WM. 1987. Maxillary suture obliterations: Aging the human skeleton based on intact or fragmentary maxilla. Journal of Forensic Sciences 32: 148-157.

34. Meindl RS, Lovejoy CO. 1985. Ectocranial suture closure: a revised method for the determination of skeletal age at death based on the lateral-anterior sutures. American Journal of Physical Anthropology 68: 57-66.

35. Moore-Jansen PM, Ousley SD, Jantz RL. 1994. Data collection procedures for forensic skeletal material: Report of Investigations No 48. Department of Anthropology, University of Tennessee, Knoxville.

36. Nakhaeizadeh, S, Hanson, I, Dozzi, N. 2014. The power of contextual effects in forensic anthropology: A study of bias ability in the visual interpretations of trauma analysis on skeletal remains. Journal of Forensic Sciences 59: 1177-1183.

37. Nakhaeizadeh, S, Morgan, RM, Rando, C, Dror, IE. 2017. Cascading bias of initial exposure to information at the crime scene to the subsequent evaluation of skeletal remains. Journal of Forensic Sciences 63: 403-411

38. Ousley, S. 1995. Should we estimate biological or forensic stature. Journal of Forensic Sciences 40: 768-773.

39. Oxenham, MF., Knight, T., Westaway, M.C. 2008. Identification of Australian Aboriginal mortuary remains. In: Oxenham, M.F. and Tayles, N. (eds.). Forensic Approaches to Death, Disaster and Abuse. pp: 37-54. Queensland: Australian Academic Press.

40. Pretty, GL, Henneberg, M, Lambert, KM, Prokopec, M. 1998. Trends in stature in the South Australian Aboriginal Murraylands. American Journal of Physical Anthropology 106: 505-514.

41. Scheuer, L, Black, S. 2000. Developmental Juvenile Osteology (1st ed.). London: 1Elsevier Academic Press.

42. Scheuer, JL, Musgrave, JH. Evans, SR. 1980. The estimation of late fetal and perinatal age from limb bone length by linear and logarithmic regression. Annals of Human Biology 7: 257-265.

43. Scott, GR., Turner, II CG., Townsend, GC., Martinon-Torres, M. 2018. The Anthropology of Modern Human Teeth. (2nd edn) Cambridge: Cambridge University Press.

44. Steele, DG., McKern, T.W. 1969. A method for assessment of maximum long bone length and living stature from fragmentary long bones. American Journal of Physical Anthropology 31:215–227.

45. Steele, DG. 1970. Estimation of stature from fragments of long limb bones. In: Stewart, TD. (ed.). Personal identification in mass disaster. pp. 85-97. Washington, DC: Smithsonian Institution Press.

46. Stewart, TD. 1958. The rate of development of vertebral osteoarthritis in American whites and its significance in skeletal age identification. The Leech (Johannesburg) 28: 144-151.

47. Stewart, TD. 1962. Anterior femoral curvature: its utility for race identification. Human Biology 34: 49-62.

48. Trotter, M. 1970. Estimation of stature from intact long bones. In: Stewart, TD. (ed.). Personal Identification in Mass Disasters. pp 71-83. Washington DC: National Museum of Natural History.

49. Trotter, M, Gleser, GC. 1952. Estimation of stature from long bones of American Whites and Negroes. American Journal of Physical Anthropology 10: 463-514.

50. Trotter, M, Gleser, GC. 1958. A re-evaluation of estimation of stature based on measurements of stature taken during life and of long bones after death. American Journal of Physical Anthropology 16: 79-123.

51. Trudell, MB. 1999. Anterior femoral curvature revisited: Race assessment from the femur. Journal of Forensic Sciences 44: 700-707.

52. Winburn, AP., Stock, MK. 2019. Reconsidering osteoarthritis as a skeletal indicator of age at death. American Journal of Physical Anthropology 170: 459-473.

53. Wright, R. 1992. Correlation between cranial form and geography in Homo sapiens: CRANID – a computer program for forensic and other applications. Archaeology in Oceania 27: 128-134.

54. Wright, R. 2008. Detection of Likely Ancestry Using CRANID. In: Oxenham, M. (ed.). Forensic Approaches to Death, Disaster and Abuse. Bowen Hills, Qld.: Australian Academic Press: pp 111-122.

Level 6, Tower 3, World Trade Centre
637 Flinders Street, Docklands Victoria 3008
DX 210096 Melbourne

T +61 3 9628 7211 F +61 3 9628 7253
E secretariat.nifs@anzpaa.org.au

www.anzpaa.org.au/nifs

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Australia New Zealand
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NATIONAL INSTITUTE OF FORENSIC SCIENCE AUSTRALIA NEW ZEALAND