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## Standard for Age Estimation in Forensic Anthropology



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## Foreword

This standard was revised, prepared, and finalized by the Anthropology Consensus Body of the AAFS Standards Board (ASB). The Anthropology Subcommittee of the Organization of Scientific Area Committees (OSAC) under the guidance of the National Institute of Standards and Technology (NIST) recognizes age estimation as an important component of the biological profile and has used the document initially published by the Scientific Working Group of Forensic Anthropology (SWGANTH).

This document is intended to assist forensic anthropologists when estimating age from complete or partial human skeletal material. Age is one of several biological parameters that can be estimated from skeletal material or radiographic images of skeletal elements. Age estimation is based on a relationship between biological changes to the skeleton and time, either through the subadult period encompassing growth and development of the skeletal system, or the adult period encompassing the end of development and skeletal degeneration. Age estimation serves as a foundation for developing other essential estimates of a biological profile. Accurate and valid age estimation is dependent upon accurate estimates of other biological parameters, such as ancestry and sex. The interplay between age estimation and the rest of the biological profile is complex.

In the forensic setting, the estimated age interval of an unidentified individual is often compared to the age listed in a missing persons report and may be used as a basis to either include or exclude the individual from further consideration. Unless substantial differences in age exist, age should not be the sole basis for exclusion.

All hyperlinks and web addresses shown in this document are current as the publication date of this standard.

**Keywords:** *Forensic anthropology, age estimation, biological profile, personal identification.*

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# Standard for Age Estimation in Forensic Anthropology

## 1 Scope

Age is one of several biological parameters that can be estimated from skeletal material or radiographic images. This standard provides procedures for the estimation of age from skeletal material or radiographic images. This standard includes the estimation of age at death from skeletal remains and can also be applied to skeletal development from living individuals.

Specific methods and techniques are not included in the standard.

## 2 Normative References

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

## 3 Terms and Definitions

### 3.1

#### **age estimation**

The estimation of chronological age from osseous, dental, and/or cartilaginous material.

### 3.2

#### **age mimicry**

When an applied age estimate approximates (i.e., “mimics”) the age distribution of the reference sample upon which the method was based.

### 3.3

#### **biological profile**

The description of an individual’s estimated sex, ancestry, age, and living stature derived from an anthropological (skeletal) analysis.

### 3.4

#### **chronological age**

The age of an individual in years, months, and/or days.

### 3.5

#### **dental development**

Growth and maturation of the dentition.

### 3.6

#### **dental eruption**

The process of emergence of the primary (deciduous) or secondary (permanent) teeth through the alveolar bone.

### 3.7

#### **secular change**

Change in phenotype (e.g., stature) in a population over time.

## **4 Requirements**

### **4.1 General**

Skeletal remains shall be analyzed in a reliable and systematic manner to estimate age. Methods applied to estimate age shall be appropriate for the skeletal elements available. All methods used shall be documented to allow verification and replication of the work performed.

Age estimation shall be made independently of suspected or presumptive identification to minimize bias.

Extensive knowledge of skeletal anatomy, including the range of normal human variation and experience with various age-estimation methods, is required.

Age estimation from skeletal remains should be conducted even if DNA or other analyses will be performed.

Age estimation shall follow methods published in peer-reviewed sources and shall be reported as an age interval. Existing reference standards for a method shall be used.

If one or more of the bones or features needed to apply a specific method are absent, the method shall not be used. The quality of available skeletal material shall be considered when selecting a method.

All test results and observations shall be documented and described, including those that are inconsistent with the final age estimate.

### **4.2 Procedure**

#### **4.2.1 General**

Choice of age-estimation methods shall be dictated by the skeletal elements available, their condition/degree of preservation, and the general age of the individual (i.e., subadult vs. adult remains). When multiple methods are available, the method(s) with the greatest accuracy and most appropriate reference sample(s) shall be given greater consideration when synthesizing an age estimate. Age estimates from multiple methods shall not be averaged.

Published methods shall be followed. Whenever possible, methods developed on a population representative of the unknown skeleton shall be used.

#### **4.2.2 Fetal Age Estimation**

Fetal age estimation shall be based on long bone lengths, individual bone development, and/or developing dentition.

#### **4.2.3 Infant and Child Age Estimation**

Infant and child age estimation shall be based on dental development, dental eruption, and/or osseous development (e.g., primary centers of ossification and maturation of other skeletal elements). Age estimates based on dental development are the most accurate and shall be given greater consideration.

#### **4.2.4 Adolescent/Young Adult Age Estimation**

Adolescent and young adult age estimation shall be based on dental development, dental eruption, epiphyseal formation, and/or epiphyseal union.

#### **4.2.5 Adult Age Estimation**

Adult age estimation shall be based on skeletal maturation, degeneration, and/or microscopic features.

#### **4.2.6 Considerations and Adjustments**

When prioritizing method selection, consider potentially confounding factors, such as socio-economic status, secular change, pathological conditions, trauma, taphonomy, and biomechanical demands on the skeleton. Age predilection of some pathological conditions may offer insights into age estimations.

In theory, radiographic age-estimation protocols can also be used to analyze skeletal development in living individuals. In practice, however, these applications are limited in their utility. Most commonly, age estimation in the living is used to determine whether or not an individual has reached the age of majority (i.e., if the individual has reached legal adulthood). Considering the widespread variation in timing of epiphyseal union or dental development based on sex, population, or factors unique to an individual (e.g., genetics, environmental stress), it is acknowledged that rarely, if ever, could a practitioner say with certainty that an individual near the age of majority is either a minor or an adult. If such estimates are made, the practitioner shall be forthright regarding the associated error and/or uncertainty.

Age mimicry may represent a complicating factor when estimating age.

Methods used to age younger individuals typically result in more narrow intervals than those for older individuals. With increasing chronological age, the variation produced by environmental factors and life history tends to increase.

Both sex-based and population-based variation exists in dental and osteological development.

#### **4.2.7 Reporting**

An age estimate shall be reported as an interval (e.g., confidence interval). A point estimate may be reported as well.

All techniques used shall be documented to allow verification and replication of results.

Raw data shall be recorded and maintained.

## Annex A (informative) Bibliography

The literature presenting method development, method validation, and case studies of age estimation in forensic anthropology is extensive. The following bibliography is not intended to be an all-inclusive list or a robust literature review. The goal of the bibliography is to provide one or two examples of publications focused on points addressed in the standard. Additionally, any mention of a particular software tool or vendor as part of this bibliography is purely incidental, and any inclusion does not imply endorsement.

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<sup>1</sup> Free to download at [http://http://fac.utk.edu/wp-content/uploads/2016/03/DCP20\\_webversion.pdf](http://http://fac.utk.edu/wp-content/uploads/2016/03/DCP20_webversion.pdf)

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