

ABFO Standards and Guidelines for Dental Age Assessment

These standards and guidelines are the collective effort of the American Board of Forensic Odontology, Age Assessment Committee. The use of these standards and guidelines is intended to enhance the quality of forensic dental age assessment and reporting.

Use of other age assessment modalities such as anthropologic methodologies should be considered if available. All age assessment methods have advantages and shortcomings, and are dependent upon the availability or existence of suitable population specific reference data.

Purpose and Value

Forensic dental age assessment results in the estimation of an individual's chronologic age through scientific evaluation of the dentition and surrounding structures. Medico-legal applications in the deceased include estimation of the age at death to narrow search parameters and thereby assist in the identification of missing and unidentified individuals. In situations involving living individuals, dental age assessment has assisted in immigration, legal age of majority and legal age of license cases. Forensic dental age assessment practitioners should utilize the developed guidelines and standards to the fullest extent applicable, practical and appropriate to ensure scientific integrity.

General Principles

Method(s) to be employed depend upon the specific circumstances of each case. The analysis of fetal, infant, child, adolescent and adult dentitions may involve various techniques including gross examination, the use of radiographic analysis, histologic and biochemical evaluation. Forensic age assessment guidelines recommend approaches for estimating age giving consideration to the likely age range of the individual. Thoughtful consideration should be given to sex, ancestry, population specificity and environmental factors.

Definitions

Standards: Established protocols that are compulsory minimal level of practice.

Guidelines: Recommended procedures that help direct but are not required.

The use of the words “shall”, “should” and “must” follows the 2003 American National Standards Institute (ANSI) , https://www.usug.org/answg/pdf/ANSI_Style_Guidesheet_-_2003.pdf, style guidelines on the correct form of requirements and recommendations:

- **Shall** is the correct verb form for indicating a requirement. Use **shall** for indicating a mandatory aspect or an aspect on which there is no option.
- **Should** is the correct verb form for indicating a recommendation where it is considered the best among numerous options or there is insufficient scientific evidence to definitively support its mandatory use.
- **Must is NOT a term recognized by ANSI and shall not be used**

Dental Age Assessment: The processes used to produce an estimation of an individual’s chronologic/biologic age using dental data.

Dental Age Estimation: The mean age, age interval, and corresponding measure of the uncertainty that results from Dental Age Assessment.

Technique: A method or procedure used for age assessment.

Study: A detailed investigation and analysis of a specific population to relate chronologic age to dental development.

Rate of Uncertainty: The statistical error rate that should minimally reflect 95% of a given population or two (2) Standard Deviations (SD). If SD is not the statistical error rate utilized by a published study, then the appropriate corresponding error rate used by that study should be reported.

Prenatal/Fetal Dental Age Interval: That interval in human dental development that occurs prior to birth.

Infant/Child Dental Age Interval: That interval in human dental development that includes the postnatal presence of the developing and resorbing primary dentition including the period of mixed primary and secondary dentitions.

Adolescent Dental Age Interval: That interval in human dental development that includes the presence of the developed and developing secondary dentition. Retained primary teeth may also be present as a special circumstance during this interval.

Adult Dental Age Interval: That interval in human dental development where all teeth present have completed crown/root development and are therefore considered dentally mature.

Standards

1. The odontologist shall provide appropriate and accurate assessments of chronologic age utilizing scientific methodology.
2. The odontologist shall be familiar with currently recommended age assessment methods and shall utilize the appropriate age assessment method(s) for the case at hand.
3. The odontologist shall consider all available information, including sex, ancestry, population specificity, biological information and environmental factors.
4. The odontologist shall utilize the most appropriate statistical data to apply in the assessment of an individual's chronologic age.
5. When practical, the odontologist shall use multiple independent statistical methodologies and shall report the results of each independent statistical method utilized.
6. The odontologist shall precisely follow the specific methodology outlined, including morphologic staging and criteria measurements, within the study being utilized for the selected age assessment technique when estimating chronologic age.
7. When the technique utilized allows, the odontologist shall include a probability statement that the individual has attained the age in question for immigration and legal age of majority cases.

Guidelines

The Odontologist **Should** Record:

1. Case Identification Data:
 - a. Case number
 - b. Referring agency (Person requesting the age estimation)
 - c. Name of the examiner(s)
 - d. Date of the examination
 - e. If known, the individual's name and stated date of birth
 - f. Other pertinent informational data
2. Biographical Information of the Individual:
 - a. Ancestry and geographic population specificity
 - b. Sex
 - c. Nutritional health
 - d. Current and prior systemic diseases
 - e. Socioeconomic status
 - f. Habits and addictions that may affect health or the maxillofacial structures
 - g. Any other environmental factors that may affect morphologic or post-formation dental and skeletal development

3. Dental Evidence Observed, Collected and Measured:
 - a. Specific teeth utilized in the evaluation.
 - b. Age assessment criteria including but not limited to:
 - i. Morphologic developmental staging
 - ii. Eruption Pattern
 - iii. Root translucency, Secondary dentin apposition, attrition, periodontal health, or any other measured dental developmental or post-formation characteristics.
 - c. Occlusion
 - d. Oral hygiene
 - e. Pathology
 - f. Photographs (Document Photographer and Agency Affiliation)
 - g. Radiographs (Document Radiographer and Agency Affiliation)

4. Dental Age Assessment Methods/Techniques:

Atlas

Atlas dental age assessment techniques utilize diagrammatic representations of the morphologic developing tooth structures with their associated eruption pattern. Atlas techniques are non-sex specific and have a limited number of population specific data sets resulting in a higher degree of variability particularly in mid-childhood through adolescence. In addition, Atlas techniques are often derived from mixed ethnic data. Atlas techniques are particularly useful in mass disaster and clustered victim situations due to their ability to rapidly segregate child, adolescent, and adult remains into age intervals.

Infant/Child

Infant/Child dental age assessment techniques utilize radiographic evaluation to stage the degree of morphologic development of the primary and/or secondary dentition as well as resorption of the primary dentition. Infant/Child techniques should consider sex, ancestry, and population specificity. Therefore, these techniques will generally provide a more accurate and reliable estimate of age over eruption and atlas methodologies.

Adolescent

Adolescent dental age assessment techniques utilize radiographic evaluation to stage the degree of dental development toward the latter half of dental morphologic maturation. Although, the third molar exhibits the highest degree of morphologic developmental variability, it remains extremely useful in the assessment of age. While teeth other than the third molar continue to undergo morphologic development, early adolescence age assessment methodology should be utilized. Late adolescent age assessment techniques should be utilized when the third molar is the only remaining tooth continuing to undergo morphologic development. These techniques play a useful role in assisting legal authorities in determining the disposition of cases involving immigration, asylum seekers and legal age of majority or license.

Adult

Adult dental age assessment techniques may utilize radiographic morphological evaluation as well as gross and microscopic observation of post-formation changes within the dentition following the cessation of morphologic dental development. Although others have been described, there are six traditional post-formation variables that have been utilized in the assessment of adult chronologic age. They are: root transparency, secondary dentin deposition, periodontal attachment, cementum apposition, attrition and root resorption. The most useful of the criteria are root transparency and secondary dentin deposition. The least valuable criterion is root resorption. Ethical considerations may restrict the use of many adult age assessment methodologies due to the requirement of sacrificing tooth structure.

Biochemical

Biochemical dental age assessment techniques require the sampling of dental tissues for evaluation. Current techniques include analysis of amino acid racemization and determination of the level of radioactive carbon in dental enamel. Racemization techniques estimate age at tooth extraction or death while radioactive carbon analysis estimates the date of birth for individuals born after 1943. These techniques are useful in all age groups and offer a relatively narrow age estimation interval. However, they introduce ethical considerations for tooth sampling in the living and are laboratory procedures that require considerable time and cost to process.

The Forensic Dental Age Assessment Report Should Include:

Introduction:

This section provides background information which should include;
Case Identification Data
Biographical Information regarding the individual

Inventory of Evidence:

This section lists all evidence received, observed and/or collected by the forensic odontologist and details the source of the evidence

Method(s) of Analysis:

This section describes the analytic method(s)/scientific technique(s) and population specific data used in the dental age assessment. A list of anatomic structures analyzed, specific technique(s) utilized, and the published study where statistical data was obtained should be included in the final forensic report.

Opinion/Conclusions:

This section summarizes the expert's results which should include: an overall estimate of chronologic age and an estimate of chronologic age for each technique utilized, preferably with an associated age interval at a rate of 95% certainty (2 standard deviations). Additionally, when appropriate to the case, a probability statement regarding an individual's attainment of specific age.

Disclaimer:

A disclaimer statement indicating that the opinion is subject to review and/or modification if additional information or evidence becomes available.

Summary

The final age assessment results from the dental provider's expert judgment by considering all available information. Conclusion statements specific to each methodology employed should include an estimated mean age and age interval and an associated rate of uncertainty. When the information is available, the rate of uncertainty should statistically consider 95% of the specific population, or two standard deviations. If the peer reviewed published scientific study(s) utilized to assess chronologic age do not provide two standard deviation statistical rates of uncertainty, then, the rate of uncertainty defined by that study should be clearly stated in the forensic report.

Resources:

ABFO Supplemental Age Assessment Charts: <http://abfo.org> (Located under Resources Tab)

- ABFO Dental Age Assessment Procedures Chart
- ABFO Child/Adolescent Dental Age Assessment Technique Chart
- ABFO Adult Dental Age Assessment Technique Chart

Lewis, J.M., Senn D.R., 2013. Dental age estimation. In: Senn, DR, Weems RA (Eds), Manual of Forensic Odontology, 5th Edition. Taylor and Francis Group, Boca Raton, FL, pp. 221-255.

Harris, E.F., Mincer H.H., Anderson K.M., Senn D.R. 2010. Age estimation from oral and dental structures. In: Senn, D.R., Stimpson, P.G. (Eds), Forensic Dentistry, Second edn. Taylor and Frances Group, Boca Raton, FL, pp. 263-303.

Nelson, Stanly J., and Major M. Ash. 2010. Development and eruption of the teeth. In *Wheeler's Dental Anatomy, Physiology, and Occlusion, Ninth edn.*, 21-44. St. Louis: Saunders Elsevier.

V. Gilsanz and O. Ratib 2010. Hand Bone Age: A Digital Atlas of Skeletal Maturity, Second Edition, Springer.

http://www.chospab.es/biblioteca/DOCUMENTOS/Atlas_of_Hand_Bone_Age.pdf

ABFO Dental Age Assessment Workshop (Check ABFO Website for current dates):

<http://abfo.org>

Draft Age Estimation Quicksheets™ (Assists the odontologist in calculating age, age range and rate of uncertainty using Excel Spreadsheets):

DAEQuicksheets@gmail.com

UT Age Program (Assists the odontologist in calculating age, age range and % probability of having attained a specific age. For use on Adolescents with developing third molars)

<http://logisys-consulting.com/agesetup.msi>

London Atlas of Tooth Development and Eruption 2010 Interactive Website:
<https://atlas.dentistry.qmul.ac.uk>

Dental Age Research London Information Group (DARLInG): This assembly of pages, diagrams, numerical explanations and statistics has been written to provide a detailed and understandable explanation of the theory and practice of Dental Age Estimation. In addition, a library of Dental Age Assessment articles can be located on this web site.

<http://www.dentalage.co.uk/>

International Organization for Forensic Odonto-Stomatology (I.O.F.O.S.):

<http://www.iofos.eu/>