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Age determination: In relation to specific demands of forensic practice

Bijay Kumar Prasad, Pankaj Kumar, Yogesh Kumar Tyagi

Department of Forensic Medicine, College of Medical Sciences, Nepal
Department of Respiratory Virology, VP Chest Institute, University of Delhi, Delhi-110007, India
Department of Biochemistry, VP Chest Institute, University of Delhi, Delhi-110007, India
Contact: the corresponding author Pankaj Kumar · panky8@yahoo.com

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ABSTRACT

Age determination in cadavers, human remains and living individuals may clarify issues with significant legal and social ramification for individuals and in community. In cases of age estimation, medical ethics and legal rules are the important factors, which should be considered. The choice of method has to take account of the individual circumstances of each case. Most methods require either the consultation of specialized and trained scientist. The methods must be presented to the scientific community, as a rule by publication in review form and the methods should be scientific accurate and results should be reproducible .In this review we have described some important method of age determination and legal and social issue involved in age determination in forensic medicine..

Keywords: Age Estimation, Clinical Forensic Medicine

Need of accurate methods for age determination in forensic practice

TThe need for accurate techniques for age estimation has never been grater than last two decades because of two main reasons related to current sociopolitical development. The first reason is increasing number of unidentified cadavers and human remains, the second reason is rise in cases requiring age estimation in living individuals with no valid proof of date of birth. These developments have greatly underlined the importance of aging both in human remains and living individuals.

The implications of " lack of identification" of a cadaver are not to be underestimated. Appropriate identification is important not only for administrative and ethical reasons, but also because of

serious legal consequences. In civil law the death of person (which can only be proclaimed following correct identification of the deceased) changes the civil and juridical status not only of the deceased but also of the relatives. Death has major economic and financial ramification for the relatives arising from issues of inheritance and insurance. In criminal law, lack of identification seriously hampers murder enquiries. Finally false or unidentified cadavers offer an opportunity to illegally obtain identity documents and thereby switch identity.

When attempting to match unidentified remains against hundreds of missing individuals, age is a primary crucial factor for preliminary screening procedures. Age estimation is therefore one of the slandered request made be police and juridical authorities upon the discovery of dead body.

Estimation of age is also becoming crucial in living individuals. Many countries have registered in increase in the influx of individuals lacking valid identity documents (e.g. refugees, illegal immigrants). This is resulted in an increase in the prison population of foreign juvenile delinquents with no valid documents. Knowledge of age of living individuals without valid documents may be required to clarify legal questions concerning the imputability of juvenile or young adult delinquents. Pension claims of older individuals or requests for political asylum [1].

The demands of methods of age determination are dependent on circumstances of individual cases. In many cases an appropriate age estimation by trained and experienced persons based on anthropological / dental status, which can be performed quickly and immediately, is sufficient for example for confirmation of the identity of a deceased in connection with other findings. However, in other cases age estimation is has to be as accurate as possible- for example if the identity of a victim of a murder case is unclear or if legal questions concerning the imputability of young delinquents have to be clarified. In such cases age estimation may play a central role in clarification of questions, which have a major legal and social impact for individuals as well as for community; this is the peculiarity of age estimation in forensic practice. In such a framework, methods of age estimation have to fulfill specific demands.

The main question: Which methods can fulfill these specific demands

Numerous papers concerning age estimation have been summarized in different review articles and in books [2-5]. Most of the review gives indications as to the preferred methods according to the authors. But usually no statistically founded reasons for such a choice are given. Not infrequently methods which are commonly considered inaccurate (such as ectocranial suture closure) are still recommended. This may be mainly ascribed to the lack of consistent data concerning the accuracy of methods for age estimation. Studies that test various methods in an independent material are rare and as rule limited to special fields (e.g. dental and skeleton methods) [6-9]. A comparison of different methods with regard to their accuracy based on published original data can be performed only with severe limitations. The methods have been developed on the samples of differing or unknown size and age structure. In many cases there is lacking of details regarding the procedures used and in some cases there are even statistical inconsistencies [10].

This overview is an attempt to summarize relevant information about these methods and to give recommendations for their application. We have attempted to restrict cited literature to original, basic and/or recent literature which we believe will be of greatest value.

Methods for age determination

In childhood, age estimation can be performed by using morphological methods, because a great number of age dependent morphological features especially of dental and skeleton system can be evaluated. At the end of skeletal growth and development, only a few age dependent features like development of third molars and of bones of wrist and hand remain to be used for age estimation by morphological methods, resulting in decrease in accuracy with increasing age. In adulthood, the accuracy of most morphological methods is poor: In this age group a biochemical method based on aspartic acid racemization in dentine offers the most accurate results.

Table-1 shows the methods for age estimation in childhood and adolescence. Table 2 shows recommended method for age determination in adulthood. The detail method for age estimation can be obtained from the cited literature.

Table 1. Showing Recommended methods for age determination in childhood and adolescence, critical remarks and relevant literature.

Methods	Recommended		Remarks
	For	In age ranges	
• Radiological examination of dental development 1a. ..of all tooth types 1b ...of the third molars	Cadavers/ Human Remains Historic and Archeological cases And living individuals As (l. a.)	0-14 y c. 14-21 y	With increasing Age, less accurate [11-13] As (l.a.) [14-16]
• Radiological examination of skeleton development	Cadavers/ Humans Remains, Historic and Archeological cases And living individuals	0c-18y	With increasing Age, less Accurate. Sex, race and environment influence It. [17-19]

Table 2. Showing Recommended methods for age determination in adults, critical remarks and relevant literature.

Methods	Recommended		Remarks
	For	in age ranges	
• Evaluation of dental morphology including historical features l a. Combined methods e.g. “Gustafson method” l b. Methods based on cementum Annulations	Cadavers permanent, human remains. living individuals, As (l a) Also on historical and archaeological cases	All ages with Teeth As (l a)	Influence of sex, race is unclear [20-22] with increasing age less accurate [23-25]
• Determination of aspartic acid racemization in dentine	Cadavers, human living and individuals remains,	All ages with availability of teeth	Should not applied in burnt remains influence of sex, race is doubtful [26-28]
• evaluation of skeleton morphology 3a. Macroscopic features ... .public Symphysis 3b. Evaluation of bone histology 3c. Mutifactorial Methods considering several features	Cadavers and human remains, historic and archeological cases As (3.a.) As (3 a)	<40y All ages All ages	With increasing age, less accurate. Sex race influence it. [29,30] Possible sex difference in histological features should be considered. Influence of race is unclear. [31.32] As (3.a) and (3.b.) depending on included features, with increasing age less accurate. [33,34]

Final remarks

1. The choice of method has to be consider the specific circumstances of the individual cases. In details, the following questions must be clarified to enable an optimal choice: What accuracy is

needed? Which age range is to be expected? Are sex, race, and ethnic origin known and to be considered? In cadavers: Which material can be analyzed (Elapsed time since death? Environmental factor?)? In living individuals: Which ethical and legal regulations have to be considered?

2. Published data should not be used uncritically for age determination. Special education and training is required for the application of all effective methods. An adequate calibration by each "user" is to be strongly recommended to avoid systemic errors.

3. Every recommended method is represented by several scientific groups, each of them using their very own methodological protocol and different procedures for evaluation of their method. This leads to several limitations in compatibility, reproducibility and verification. In a time in which quality control has achieved a great importance in all fields of the biomedical sciences it is surprising how few attempts have been made to find common standardization, calibration and evaluation procedures for methods for age determination. At the moment, there are no generally accepted guidelines concerning quality assurance in age estimation. Efforts in these directions are necessary in order to guarantee quality standards and adequate answers to the important legal and social issue of age estimation in forensic medicine.

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