

Age Estimation in Middle Aged Adults: An Administrative and Clinical Forensic Medicine Issue for Hospital Management

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Abstract

Age in middle aged adults is an important factor in certain legal and administrative matters like determination of eligibility for a particular employment or post, fixing of retirement age of an individual etc. Hospital administrators may also face such an issue. The current medical methods in age estimation include assessment of skeletal changes which helps in arrival of the approximate age range based on medical criteria, literature and previous studies. The age estimation in the middle aged individuals (45-65 years) is a difficult task due to the factor that at the end of examination, conclusion drawn is given in wide age range. This may be of minimal use to the administrators or employers as they require a specific age or at least a short age range to finalize the issues in question. So, for purpose of the administrative matters for fixing a particular age the criteria which may be used have been discussed in the article. Further studies and multiple other factors which determine these skeletal changes needs to be studied and a method should be improvised for proper conclusions. There is also a need for standardization of criteria for arriving at scientifically reasonable conclusions in determination of age. Virtual autopsy is a boon in this aspect and opens door for study of possible parameters and determinants in age estimation.

Keywords: Age estimation; Age clinic; Skeletal Changes; Cranial suture fusion; Symphysis pubis; Forensic anthropology; Hospital Administration.

Introduction

Age is an important factor in determining certain legal responsibilities, eligibility for some desired posts and also marks the end of service under Government agencies. Age is mainly evaluated by birth certificate from registration department of births and deaths. In absence of birth certificates, many other documents like class tenth mark sheet of school, village panchayat certificate, hospital birth documents, Aadhar card, Voter ID etc may be considered. The issue of determining age arises

when there is a complaint of falsification of these documents or in cases where no such document is available to prove the age. In such cases the only method of determining age is medical examination of the individual. Age related issue can arise in both criminal proceedings, as well as civil suits related to employment, age of superannuation, marriage etc. Radiographs of joints and bones along with the dental changes are used to estimate skeletal age of an individual. The Medical examination thus involves assessing different parameters and is given in a range. A short age range can be opined

in young individuals of less than 18 years of age but with increasing age this range becomes wider. The referring authorities and some procedural outcomes usually expect and sometimes insist an exact age or a very short range and are not satisfied with Medical opinion. One such challenging age group is that of middle age, it is that period of an individual where there is a transit between young adulthood and old age, the age range usually accepted as 'middle age' is between ages 45 and 65.¹⁴ The aim of this review is to discuss the circumstances that result in requests for age assessment in middle aged individuals, problems faced in the Hospital at the Clinical Forensic examination, scientific parameters used for age determination and possible solutions for sorting out the issue.

Problem Faced at the Administrative Level

Age estimation is a challenging area not only when criminal proceedings are undertaken, but also in various administrative matters as well. Age estimation in middle age is usually requested in cases like

- Age criteria for holding posts and there is allegation of false certificates.
- Superannuation of an individual.
- Inconsistent records having ambiguous age mentioned in different records.
- Skeletal remains of an individual who belongs to middle age
- Unknown dead bodies appearing to belong to middle age.
- Civil suits related to inheritance of property.

One frequent problem being faced at the administrative level is when a dispute arises regarding age of a pensioner. In our country, in individuals who are now in the age group of 45-65 have a questionable documentation regarding their age. The reason for this being absence of mandatory documentation/registration of the birth before the implementation of 'The Registration of Births and Deaths Act, 1969' in our country.

Dr Ramnath Jha, discussed on "Upping Retirement Age in India."⁵ He stated that, "On 12 Nov 2019, newspapers reported a statement arguing for rising the age of retirement beyond 60 years. Now a days people remain physically fit to work even after completing the age of 60 years. The retirement age of employees should be increased". If such effort of re employment and superannuation

takes place, many will come forward claiming their age to be of the required category. The challenges regarding verification of age by an officer-in-charge will be daunting in absence of proper documentation and sometimes simply left on the discretion of the Officer-In-Charge regarding verification of the papers submitted to him/her.

The concerned officer-in-charge has to take reasonable steps to verify the information submitted to him. If the officer-concerned is not satisfied with the document provided by the appellant for age verification, he/she can seek alternate domain for the age verification like taking help of the medical examination. The real challenge begets the verification of age in individuals of the middle age group. With age estimation already being a tough task in younger age group due to high variability of different factors, verification of the same in above 45 years where the changes are very subtle becomes quite the daunting task.

Medico Legal Importance of Age

There is medicolegal importance of every age group among people which varies according to civil or criminal requirements as well as varies for different countries. Beyond 45 years most of the cases belong to civil suits or civil formalities determine age of superannuation and employment disputes. The medicolegal importance of age above 45 years in reference to Indian constituency is as below 6:

Medico-legal Importance of 50 years Age

It is upper limit of eligibility for employment in various government services.

Medico-legal Importance of 58 years and 60 years age

The age of retirement varies in different states of the country with few states retiring its employees at 58 years and other at 60 years. The age for senior citizen concession in Indian railways is 58 years for females and 60 years for males.

Medico-legal Importance of 65 years

As per Section 10 (2) of the Consumer Protection Act 1986, a member of District Forum can hold his/her office not more than a term of 5 years or up to the age of 65 years, whichever earlier. The retirement age for doctors in the Ministry of Health and Family welfare, Government of India is 65 years.

Criteria used for Age Estimation in Middle Age 45-65 years

The current medical practice utilizes determination of changes in the bones which is interpreted by radiological investigations like X-ray or CT-scan. There is limitation of choice of radiological study of bones in this age group as after fusion of all the major bones including long bone the correct estimation of age becomes difficult. The following are few of the parameters considered among the living in the age group of 45-65.⁷⁻¹¹

A. Changes in Symphysis Pubis

As the age advances the degenerative changes in Symphysis Pubis starts. The irregular surface of symphysis pubis bone starts becoming more granular or smooth. It partly becomes granular around 25 years with well defined inner and outer surface. Granularity becomes more extensive by 35 years; also the lipping of the pubic symphysis face commences at 35 years of age. During the middle age group in the early 50's symphyseal surface is oval, smooth with raised upper and lower margins, which become beaded in late 50's. The surface starts to erode during 60's and the erosion becomes irregular by 70's. Among living these changes can be seen through computed tomography (CT scan).

Table 1: Changes in pubic symphysis in middle age.

Age of person*	Characteristics
During early 50s (years)	Symphyseal surface is oval, smooth with raised upper and lower margins
During late 50s (years)	Surface has narrow beaded rim
During 60s (years)	Surface starts to erode with breakdown of outer margin

B. Closure of Cranial Sutures during middle age

The fusion of the cranial sutures is helpful in determining the age among middle age and elderly. The closure of the cranial suture starts endocranially and proceeds ectocranially. The union in the inner aspect of the skull occurs 5-10 years earlier than externally. The main cranial sutures suitable for age estimation post middle age are sagittal suture, coronal suture, lambdoid suture and parieto temporal suture. It occurs externally in the following order: posterior third of the sagittal suture around 30-40 years, anterior third of the sagittal and lower half of the coronal around 40-50 years and middle sagittal and upper half of the coronal around 50-60 years. Lambdoid suture closes around 45-50 years while parieto temporal

suture sutures close much later around 60-70 years.

Table 2: Skull suture closure.

Closure of sutures	Age of closure
Sagittal suture	
- Posterior 1/3rd	30-40 years
- Anterior 1/3rd	40-50 years
- Middle 1/3rd	50-60 years
Coronal suture	
- Lower half	40-50 years
- Upper half	50-60 years
Lambdoid suture	45-50 years
Parieto temporal suture	60-70 years

C. Fusion of sternum

Fusion of sternum bone starts at 20 years among male and female. Fusion completes by the age of 40 years in male and 45 years in female. A male should be considered above 40 years if fusion of sternum is complete and a female should be considered above 45 years if fusion of sternum is complete.¹² The manubrium sterni also unite with the mesosternum.

D. Scapula

Though the changes in scapula are less uniform but lipping of ventral margin of Glenoid cavity may start by 30-35 years of age. Irregular lipping occurs around clavicular facet between 35-40 years of age. Also inferior surface of Acromion process develop facet like changes in between 35-45 years of age. The triangular demarcation of scapular ridge becomes prominent by 50 years.

E. Vertebrae

Around 35-50 years, lipping of vertebral bodies can be detected. Atrophic changes occur in the intervertebral discs and osteophytes (lipping) can be seen on x-rays.

F. Dental

The dental age estimation in the living is conducted by evaluating the timing and sequence of eruption of teeth along with stage of growth and development of dentition utilizing non-invasive methods.¹³ The eruption of the teeth with age has been well studied, documented and accepted method for age determination. But after complete eruption of all the permanent teeth the assessment of age becomes difficult in adults and invasive techniques are required for assessing age. Most of the methods

of dental age estimation require tooth extraction of tooth, and hence cannot be used in living individuals. OPG or ortho pantomogram has been a popular choice for age determination in living. The radiological techniques are used to analyze apposition of secondary dentin which is a simple and convenient method. Throughout a person's life secondary dentin gets deposited along the wall of the tooth pulp, so the radiographic measurements of the pulp, tooth length as well as width and ratio of length and width are used to analyze age.¹⁴ The measurements of the pulp cavity on dental radiographs can be used as an age indicator in adults. Apart from this aspartic acid racemization technique from dentine and dentine biopsy has been used as method of age determination but latter is complex and expensive.^{15,16}

G. Other Senile Changes in Skeleton

- Beyond middle age, retrogressive changes occur in many parts of the skeleton. The thyroid and cricoid cartilages of the larynx tend to calcify and the horns of the hyoid bone unite with the body.
- The costal cartilages ossify and may unite with the sternum.
- The alveolar margins of the jaw become resorbed and the angle of the jaw is opened up.
- All the bones undergo osteoporosis changes.
- With the loss of cancellous tissue, the proximal end of the medullary cavity of the humerus assumes a cone shape, the tip of which gradually ascends, reaching the surgical neck during 41-50 years and the epiphyseal line during the age of 61-74 years. Similar changes involve the upper end of the femur also and can be seen on x-ray or by longitudinal section.

Discussion

Middle age of an individual is the transit period between young adulthood and old age, the age range usually accepted as 'middle age' is between ages 45 and 65. 1-4 Age estimation in younger age is usually based on the developing dentition, eruption of temporary or permanent teeth, growing and ossifying skeleton or in old age is by degenerative changes of the skeleton.¹⁷ Middle age is the period where the only significant dynamic change

happening in the human body is the processes of bone resorption, deposition and remodeling. This is the only criteria to assess the age of an individual during this time period, but the major problem here is that these processes are highly variable and depend on various factors like nutritional, metabolic and genetic factors which differ from person to person. The other problem is that this remodeling process of skeleton in middle age is a very subtle process and differs in the time and manner of occurrence in each individual posing a major challenge to Medical investigators.¹⁸

There are no standardized reference data to formulate uniform criteria for age determination in this age group. A lot of parameters are used to come to a conclusion which are easily questionable. Even medical literature and research studies are have variable results depending upon sample population due to variations in racial factors, environmental factors, and regional variation. So, even for radiological evaluation very less reference data is available for middle age radiological examination. Moreover the conclusions generally have a wide age range as the opinion which may be of least use for the concerned officials because the matters they need to settle have financial implications. For example if a officer has to determine the age of superannuation then the age opined in range of 45-60 years or 50-60 years will be of no use in the solution of the matter. Doctors should establish a guidelines based on which conclusions need to be drawn and UK model of " Good Medical Practice" kind of similar model responsibility needs to be taken by doctors before giving conclusions.¹⁹

Recommendations

1. The radiological age estimation is given in a range, so for purpose of the administrative matters for fixing a particular age the following criteria may be used:

- Self declaration from candidate.
- School entry Certificate.
- Last School passing certificate.
- Year of marriage.
- Age of first born child.
- Vaccination certificate.
- Oldest Driving license.
- First passport.
- Age mentioned at the time of registration in Voter list.

- Oldest employment records.

2. In India there is a need for standardization of the protocols for age determination and also regarding drawing uniform conclusions. This needs a more detailed study of the skeletal changes and also exploration of possible better and easier ways to determine age.

3. Virtual autopsy is a boon in this aspect as more radiological parameters are at disposal for study for creating a reference database. The benefit is that the PMCT data is captured as a part of routine autopsy and can be used for studying the skeletal changes at different stages of age.

Conclusion

Age estimation thus in middle age group is a very tough process considering all the difficulties in relation to medical assessment of the changes happening in the body during this period and also complex intricacies of the Administrative issues regarding the need for a very specific age of an individual to solve the complaints. This is an area where further research is needed for developing easier techniques with which age can be assessed. The benefit of doubt must be given to candidates keeping a lenient and sympathetic view. The advent of Virtual Autopsy recently in India opens the door for further research in this aspect and more needs to be explored on the timely changes happening in human bodies to estimate the age of an individual.

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