

## A COMPARATIVE STUDY OF AGE BETWEEN RADIOLOGICAL EXAMINATION OF ELBOW JOINT AND BIRTH CERTIFICATES IN MALES

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### ABSTRACT

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#### INTRODUCTION

Assessment of age by radiological examination of ossification centers of bones is useful to solve several medicolegal and civil cases. Radiological examination plays a crucial role in sensitive cases where dispute of age arises with evidence of birth certificates, school records and hospital records produced by the concerned parties.

Present study is aimed at age estimation by the process of appearance and fusion of ossification centers of bones at the elbow so as to formulate the reasonable acceptance of the age by various authorities including the judiciary and comparison of the above said with the date of birth certificates of the subjects.

#### MATERIALS

The number of subjects studied are 75 cricket players.

##### Inclusion criteria

Healthy male students aged between 10-20 years.

##### Exclusion criteria

No skeletal malformations or visible physical abnormalities.

The subjects chosen for study have been grouped into 2 as follows as per their age groups:-

1. About 35 subjects are within the age group of 11-14 years.
2. About 40 subjects are within the age group of 15-18 years. The groups were made based on evidential proof of date of birth certificates given by the subjects.

The bone age is compared with the date of births of the subjects.

#### METHODS

Anteroposterior position of the elbow joint of right hand is used.

#### RESULT

Paired T test is done. Significant P value is seen. In the age group of 10-15 there is a correlation in 26 cases. In the age group of 15-20 there is a correlation in 28 cases.

#### DISCUSSION

Assessment of appearance, maturity and union of ossification centers of bones by radiological means is an important and useful study to determine the age of a person though various physical, dental and other anthropometric methods are available. Age determination by skeletal maturity is said to be an accurate process.

#### CONCLUSION

Present study indicates that there is significant disagreement of evidential proof of age provided and the scientific observation of age of the candidates by the forensic procedure in all the two categories of age groups investigated. This study clearly indicates that a few of the parents have changed the original date of births of their children in order to get future educational benefits and service benefits.

#### KEYWORDS

Skeletal age; Ossification centers; Date of Birth (DOB).

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**HOW TO CITE THIS ARTICLE:** Krishnaprasad S, Suresh KS. A comparative study of age between radiological examination of elbow joint and birth certificates in males. J Evid Based Med Healthc 2016; 3(2), 78-81. DOI: 10.18410/jebmh/2016/17

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Submission 11-12-2015, Peer Review 12-12-2015,

Acceptance 30-12-2015, Published 06-01-2016.

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DOI: 10.18410/jebmh/2016/17

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**INTRODUCTION:** Assessment of age by radiological examination of ossification centers of bones is useful to solve several medico-legal and civil cases. Radiological examination plays a crucial role in sensitive cases where dispute of age arises with evidence of birth certificates, school records and hospital records produced by the concerned parties. When the age of a defendant is unknown bone age may be determined whether he is to be tried as a

juvenile or as an adult to determine the severity of the punishment. The process of appearance and union of ossification centers follows a definite time sequence which can be utilized for age estimation. As a general rule, the ageing of bones is more precise with respect to the appearance of centers of ossification than it is with respect to the union of epiphyses.<sup>(1)</sup> In modern society few parents have been accustomed to change the original birth dates while admitting their kids into the schools and the employees change the original birth dates for the prolongation of their service. The same is observed sometimes in sports people also. This observation made us to take up the study. Though the determination of age by medical experts is an approximate or assessment of opinion, almost all the cases are being settled by the age certificates given by the forensic experts.

Many methods have been evolved by various studies for age determination. Radiological features of certain changes in the bones is the best confirmed and reliable method than the other methods like dental examination, physical examination and union of cranial sutures as these sometimes proved misleading and their reliability is limited. Hence age can be confirmed with considerable accuracy by roentgenography of the skeleton from the time of its appearance at about 20th week of gestation up to the age of 18 years. In the long bones of upper limbs, the union occurs earlier in the elbow joint and later at the wrist. Head of the humerus is the last long bone epiphysis to unite among the bones, study of ossification centers of elbow is found to be simple and more useful. This method has been postulated and developed by Sauvegrain et al. and is a reliable tool to assess skeletal age during puberty.<sup>(2)</sup>

The present study is aimed at age estimation by the process of appearance and fusion of ossification centers of bones at the elbow, so as to formulate the reasonable acceptance of the age by various authorities including the judiciary and comparison of the above said with the date of birth certificates of the subjects.

**MATERIALS AND METHODS:**

**MATERIALS:** The number of subjects studied are 75 and their consent has been taken for the procedure. All are male students playing zonal cricket selected from Kurnool district.

**Inclusion Criteria:** Healthy male students aged between 10-20 years.

**Exclusion Criteria:** No skeletal malformations or visible physical abnormalities.

The subjects chosen for study have been grouped into 2 as follows as per their age groups, i.e., subjects falling between 1) 11-14 years and 2) 15-18 years.

1. About 35 subjects are within the age group of 11-14 years.
2. About 40 subjects are within the age group of 15-18 years. The groups were made based on evidential proof of date of birth certificates given by the subjects.

The bone age is compared with the date of births of the subjects.

**METHODS:**

**1. Radiographic positioning of the parts:**

Anteroposterior position of the elbow joint of right hand is used. The radiographers are advised to take care that lower end of humerus and upper end of ulna and radius should be viewed in the film of elbow joint in order to visualize clearly all the ossification centers.

**2. Radiographic factors:**

The skiagrams of elbow joint of right hand are taken in film of 8-10 mA/Sec at 45 to 55 k. v. The Hindustan photo film screen sensitive films of 15"x10" for pelvis and 10"x8" for hand are used by optimum processing method.

**Assigning and rating the data for age estimation:**

There are two basic types of methods that are used for medico-legal age certification.

- A) The Atlas method: In which an atlas is used to compare the radiographic films exposed of different joints that have been taken with the films printed in the atlas. Once a match is found the age is read directly off the atlas.
- B) The secondary method: Tanner and Whitehouse (TW-1 -developed in 1962 and TW2 developed in 1975) in which a score is given to every bone that is X-rayed, in accordance with existing rules of assessment. Finally the scores are added up and the final age read off a standard table.<sup>(3)</sup>

**RESULTS:** The study shows that there is a difference between the skeletal age and date of births of the individuals, Paired T Test was done. P value is significant.

**Age group 11-14 years:** Out of 35 subjects, DOBs of 26 subjects correlated with the skeletal age of the elbow joint. DOBs of 9 subjects differed. This shows that 25% wrong evidences were given in this age group.

**Age group 15-18 years:** Out of 40 subjects, DOBs of 28 subjects correlated with the skeletal age of the elbow joint. DOBs of 12 subjects differed. This shows that 30% wrong evidences were given in this age group.

Age Groups	No. of Subjects	Correlation between DOB and Skeletal Age	Non-correlation between DOB and Skeletal Age
11-14 years	35	26	9
15-18 years	40	28	12
<b>Total</b>	<b>75</b>	<b>54</b>	<b>21</b>

*Table 1*

The study indicates that there is significant disagreement of evidential proof of age provided and the scientific observation of age of the candidates by the forensic procedure in all the two categories of age groups investigated.

**DISCUSSION:** Advent of X-rays by W. K. Roentgen and subsequent development of radiologic science have brought revolutionary changes in the medical field. The process of bone maturation and skeletal development has been made easy to understand by radiological study. Ossification begins centrally in an epiphysis and spreads peripherally as it gets bigger. At first it is entirely amorphous, rounded and pinhead sized. As it grows, it takes on the osteological details of the bone. Some bones are ossified from a single center, e.g. carpus and tarsus. Most bones are ossified from several separate centers, one of which appears near the middle of the future bone. This centre is concerned with progressive ossification towards the bone ends. In all such bones, their ends are cartilaginous at birth. These terminal regions are ossified by separate centers, sometimes multiple; they are said to be secondary centers. The ageing of bones is more accurate with respect to the appearance of centers of ossification than it is with respect to the union of epiphyses. A study of various anatomical authorities shows that there is a considerable variation regarding the ages at which the various centers of ossification in the epiphyses fuse with their respective diaphyses.

Assessment of appearance, maturity and union of ossification centers of bones by radiological means is an important and useful study to determine the age of a person though various physical, dental and other anthropometric methods are available. Age determination by skeletal maturity is said to be an accurate process. Todd atlas was used in 1940s for the assessment of skeletal age. It has been replaced by the atlas of Greulich and Pyle. It is found to be very useful in assessing the developmental status of an individual child. The hand-wrist method devised by Tanner and Whitehouse is also being adopted for assessing the bone age. With a margin of error of six months, Flecker's observation states that age can be estimated by examination of physique, secondary sexual characters and ossification tests.<sup>(4)</sup>

A more recent and an advanced method of assessing skeletal maturation involves physical examination, examination of x-ray of hand and dental examination.<sup>(5)</sup>

Skeletal assessment can also be done by x-rays of olecranon process. Between 11-13 years of skeletal age in girls and between 13-15 years of skeletal age in boys, the olecranon process shows considerable changes.<sup>(6)</sup>

A simple rule of thumb, which may be borne in mind by a medical jurist and forensic expert, while asking for radiological investigations in a case, is given below.

**Generally the following findings are seen:** All epiphyses around the elbow joints fuse by around 16 years.

All epiphyses around the Hip and Ankle joints fuse by around 17 years.

All epiphyses around the shoulder and knee joints fuse by around 18 years. All epiphyses around the Wrist joints fuse by around 19 years.

Ossification centres for iliac crest and ischial tuberosity fuse at the age of 20 years.

Ossification centres for clavicle fuse by 21-22 years.

Five sacral vertebrae fuse by 22-25 years.<sup>(7)</sup>

But an exception is made by Lall and Nat in their studies in UP and Pillai in Madras wherein ossification around elbow joint is seen to extend up to 17 years.

Among the methods of skeletal age assessment radiological examination of elbow joint is selected in the present study.

About 75 normal healthy male subjects who are used to play cricket representing Kurnool district in the age group of 11-18 years are selected for this study. The skiagrams of elbow which comprises ossification centers in the lower end of humerus, upper ends of radius and ulna are taken for each individual. The skeletal maturity and the appearance of growth and union of ossification centers within epiphyses is assessed for each individual. Date of births of the subjects recorded in the school are also collected for comparative study.

In the study of the age group 11-14 years, in 9/35 subjects the date of birth according to school certificates was less when compared with skeletal age assessed by radiological examination of elbow joint. In the age group 15-18 years, in 12/40 subjects the date of birth according to school certificates was less when compared with skeletal age assessed by radiological examination of elbow joint. This shows that the subjects voluntarily entered wrong dates of birth.

It is observed in the present study that the appearance, maturation and fusion of the ossification centers is not related to height and weight of the subject. It is also observed that the maturation of bones is not uniform among the individuals of the same group.

The results are also compared with the original standards of TW1 and TW2 system by various studies mentioned in the standard text books of forensic medicine.

Though the upper age limit of complete fusion of ossification centers by the various standard methods is given as 21 years, the results are coming nearer with our subjects and with the results of various other authors in different regions and different subjects.<sup>(8)(9)(10)</sup>

Correlation between date of birth and elbow age is better appreciated in the age group of 11-14 better than the age group of 15-18.

The cause of this wide variation seen in the study is not understood precisely, hence it is not easy to determine most accurately the correct age of a subject using these methods. Bone age estimation was done by Ultrasound recently. Though it is cost effective, it is of limited clinical use because of its low accuracy.<sup>(11)</sup>

Whether the age of epiphyseal fusion is independent of the subject or related to racial and genetic factors, hereditary traits, geographic and climatic factors, dietary and socio-economic factors, disease factors or sex of the

individual is yet to be determined. Certain variations can be observed with regard to the sex, typically girls achieve adult levels of skeletal maturity at younger chronological ages than boys. The sex differences in skeletal maturation rate differ among bones-Garn et al. Roche; Thompson et al. Tanner et al. and their measurement is completed by the fact that a given radiographic appearance does not necessarily indicate the same level of maturity in both sexes.

**CONCLUSIONS:** The following conclusions are drawn after studying 75 male subjects falling in the age groups of 11-18 years by standard methods.

1. The forensic observation of evidence of age proof provided by candidates between 11-14 years and 15-18 years were investigated in this study. The study using statistical test, i.e., paired T-test has indicated that there is significant disagreement of evidential proof of age provided and the scientific observation of age of the candidates by the forensic procedure in all the two categories of age groups investigated.
2. The study emphasizes the importance of scientific method of assessment of age over birth records.
3. The study shows that there is a difference between the skeletal age and date of births of the individuals.
4. This study clearly indicates that a few of the parents have changed the original date of births of their children in order to get future educational benefits and service benefits.
5. The study can be supported by skiagrams of wrist, pelvis and dental examination for more accuracy of the analysis.

**ACKNOWLEDGEMENT:** I am thankful to Dr. L. C. Obulesu, Professor and HOD, Department of Forensic Medicine and Toxicology, Kurnool Medical College and Late Dr. MSRK Prasad, Professor, Department of Forensic Medicine and Toxicology, Kurnool Medical College, Kurnool for their guidance and integrated direction. I am thankful to the staff and subjects for their help and cooperation in making the study creditorial.

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