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A Radiological Study of Ossification at the Lower End of Humerus for Age Estimation Among Boys in North Indian Population

Jagbhan Singh[1], Vimal Modi[2]

1.PhD Scholar, Department of Anatomy, Index Medical College, Hospital and Research Centre, Malwanchal University, Indore (M.P),
2.Professor, Department of Anatomy, Index Medical College, Hospital and Research Centre, Malwanchal University, Indore (M.P),

ABSTRACT

BACKGROUND: Distal end of humerus showed complete fusion at the age of 15.5 in females and at age of 16 in males at Indian Knoll,[3] Sangma et al[4] reported that in north east region girls fusion at elbow region was found completed at the age of 16 years. The regression equation reported was 18.54 + (O) X with 4.14 as standard error. Mernchoubl PH[5] also concluded' the age 16 in Manipuri girls with reference to completion- of fusion at elbow region. **AIM & OBJECTIVE 1**. Age estimation by means of X-rays by assessing fusion of ossification centres at lower end of humerus. 2. Age estimation by means of USG by assessing fusion of ossification centres lower end of humerus. **METHODS AND MATERIALS:** The study population included 300 patients (150 males and 150 females) of 14 to 20 years of age who was required the age estimation based on Ultra sonography and X-ray according to elbow joint & compared it by their original age. Study design: A cross-sectional study. **RESULT:** In present study of 300 cases, majority of patients were in the age group of 15.1-16 years with more male patients than female (42.7% male & 35.3% female) and least were in 19-20 years (2.7% male & 6.0% female). **CONCLUSION:** Age of union of the medial epicondyle of humerus with shaft by USG and X-ray majority of patients were in the age group of 15.1-16 years. USG reported 42 (35.9%) patients more accurately than X-ray where X-ray reported 33 (28.2%) patients out of 117.

Keywords: Skeletal age; Radiological examination; Elbow joint; north Indian population; Age determination.

INTRODUCTION

Bone is essentially a highly vascular, living, constantly changing and mineralized special connective tissue, which is remarkable for its characteristic growth mechanism. Many of civil as well a criminal matters course' with the age of victim or even accused. Among various joints of a human body elbow and wrist contribute greatly in assessment of age in early age groups. In the developed part of world, reference atlas for age estimation is also in routine use.[1] Eruption of tooth and fusion of ossification centres at elbow are useful for ascertaining age range in the group 12-17 years. The areas of interest with reference to appearance and fusion of ossification centres at elbow region include lateral epicondyle with capitulum, trochea with capitulum, conjoint with shaft and medial epicondyle with shaft of humerus, head of radius with shaft and olecranon process with shaft of ulna.[2] Available data show significant deviation with variation in geographical region. Distal end of humerus showed complete fusion at the age of 15.5 in females and at age of 16 in males at Indian Knoll,[3] Sangma et al[4] reported that in north east region girls fusion at elbow region was found completed at the age of 16 years. The regression equation reported was 18.54 + (O) X with 4.14 as standard error. Mernchoubl PH[5] also concluded' the age 16 in Manipuri girls with reference to completion- of fusion at elbow region. However, Basu SK & Basu S[6] have reported the age 17 for complete fusion at elbow region in young Bengali girls.

Many methods have been evolved by various studies for age determination. Assessment of age by radiological examination of ossification centres 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 centres 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 centres of ossification than it is with respect to the union of epiphyses.[7]

METHOD AND MATERIALS

This cross-sectional study was conducted in the Department of Anatomy with collaboration of department of Radio diagnosis, Index Medical College, Hospital and Research Centre Indore MP, India from January 2021 to December 2022 after approval of Institutional Ethical committee. The study population included 300 patients (150 males and 150 females) of 14 to 20 years of age who was required the age estimation based on Ultra sonography and X-ray according to elbow joint & compared it by their original age.

Study design: A cross-sectional study

Study subjects: The subjects free from any physical disability involving upper limbs was included in the study.

Study location: This hospital-based study was conducted in Department of Anatomy and Department of Radio diagnosis, Index Medical College, Hospital and Research Centre Indore MP, India.

Study Duration: January 2021 to December 2022 (24 months).

Sample Size: 300 patients

Inclusion criteria:

- Subjects aged 14-20 years with age proof
- Both male and female.

Exclusion criteria: Patients excluded with-

- Subjects having age less than 14 years and more than 20 years
- Subjects showing any sign of disease affecting skeletal maturation.
- Subjects with history or any stigmata of previous fractures of bones (of and around the pelvis).
- Subjects with nutritional, endocrine disorders, chronic infections etc.

Study tool/ Patient's data acquisition

- Predesigned proforma
- Consent form
- Ultrasonic equipment for sonography
- X-ray machine (DR 100e Mobile X Ray System, Brand-Agfa Healthcare)

Procedure methodology:

The subjects were explained about the procedure and written informed consent was taken. The detailed physical examination was done and data regarding patient's particulars like age, sex, clinical history etc. was taken on pre designed proforma.

The radiography in the form of X-rays and USG was done. The ultra-sonographic scan of individual subject was evaluated with respect to the stage of epiphyseal ossification followed by evaluation of radiographic staging. Risser's staging system was followed in both the cases. Risser's staging system was followed.

Ultrasonological and clinical examination: Each subject was examined ultrasonologically for elbow joint of right upper limb in the Department of Radiology and subsequently, the ultra-sonogram was studied in detail by the radiologist with respect to fusion of various ossification centers. The ultra sonography was done by ultra sonographic machine. **(Ultrasound Color Doppler System*, Model*: DCU-12)**

1. Radiographic positioning of the parts: Anteroposterior position of the elbow joint of right hand was used. The radiographers were 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 centres.

2. Radiographic factors: The skiagrams of elbow joint of right hand was 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 was used by optimum processing method.

Statistical Analysis: Data was analysed using Statistical Package for Social Sciences, version 20 (SPSS Inc., Chicago, IL). Results for continuous variables was presented as mean ± standard deviation, whereas results for categorical variables was presented as frequency/number (percentage). Risser's score was also used for comparison of Xray and USG findings. Inter class correlation was done on the basis on Wilcoxon Signed Ranks Test. The level $P < 0.05$ was considered as the cutoff value or significance.

RESULT

Table No.1: Distribution of cases according to age and gender

Age Group (years)	**Male (n=150)**	**Female (n=150)**	**Total (n=300)**
14-15	18 (12.0)	36 (24.0)	54 (18.0)
15.1-16	64 (42.7)	53 (35.3)	117 (39.0)
16.1-17	48 (32.0)	19 (12.7)	67 (22.3)
17.1-18	10 (6.7)	13 (8.7)	23 (7.7)
18.1-19	6 (4.0)	20 (13.3)	26 (8.7)
19.1-20	4 (2.7)	9 (6.0)	13 (4.3)

This prospective study was carried out in the Department of Anatomy with collaboration of department of Radio diagnosis, Index Medical College, Hospital and Research Centre Indore MP. Patients of 14-20 years of age were included. Relevant data about patient's name, age, sex and clinical history were noted.

Following observations were made to accomplish aims and objectives of our study.

Out of a total 300 cases, majority of patients were in the age group of 15.1-16 years (42.7% male & 35.3% female) and least were in 19.1-20 years (2.7% male & 6.0% female). **(Table No.01)**

Table No.2: Distribution of patients according to fusion of epiphysis of lateral epicondyle with capitulum by X-ray and USG

Age Group (in years)	**No. of cases on the basis of DOB**	**Number of cases showing complete union**	
		X-ray (%)	**USG (%)**
14-15	54	24 (44.4%)	27 (50.0%)
15.1-16	117	51 (43.6%)	63 (53.8%)
16.1-17	67	56 (83.6%)	67 (100.0%)
17.1-18	23	23 (100.0%)	23 (100.0%)
18.1-19	26	26 (100.0%)	26 (100.0%)
19.1-20	13	13 (100.0%)	13 (100.0%)

We found that over all USG was more accurate than X-ray, out of 117 patients of age group 15-16 years USG reported 63 (53.8%) patients accurately, where X-ray reported 51 (43.6%) followed by same in age group 16-17 years USG reported 67(100%) patients accurately, where X-ray reported 56 (83.6%). (**Table No.02)**

Table No.3: Showing age of fusion of conjoint epiphysis with the diaphysis of humerus by X-ray and USG.

Age Group (in years)	**No. of cases on the basis of DOB (%)**	**Number of cases showing complete union**	
		X-ray (%)	**USG (%)**
14-15	54	12 (22.2%)	18 (33.3%)
15.1-16	117	40 (34.2%)	39 (33.3%)
16.1-17	67	36 (53.7%)	30 (44.8%)
17.1-18	23	23 (100.0%)	23 (100.0%)
18.1-19	26	26 (100.0%)	26 (100.0%)
19.1-20	13	13 (100.0%)	13 (100.0%)

Out on 100 patients age of fusion of conjoint epiphysis with the diaphysis of humerus by X-ray and USG majority 40 patients were in X ray and 39 (33.3%) in USG in age group 15.1-16 (117 patients) years and least 12 (22.2%) patients in X-ray & 18 (33.3%) in USG in age group 14-15 (54) years. (**Table No.3)**

Table No.4: Showing age of fusion of medial epicondyle with diaphysis by X-ray and USG.

Age Group (in years)	**No. of cases on the basis of DOB (%)**	**Number of cases showing complete union**	
		X-ray (%)	**USG (%)**
14-15	54	12 (22.2%)	15 (27.8%)
15.1-16	117	42 (35.9%)	33 (28.2%)
16.1-17	67	43 (64.2%)	30 (44.8%)
17.1-18	23	23 (100.0%)	23 (100.0%)
18.1-19	26	26 (100.0%)	26 (100.0%)
19.1-20	13	13 (100.0%)	13 (100.0%)

In study age of fusion of medial epicondyle with diaphysis by X-ray and USG the patients under the age category of 14-20 years. The majority of patients were in age group 15.1-16 (117 patients) years and least in age group 19-20 (13) years. In all age group USG was better than X-ray. **(Table No. 4)**

Discussion

The aim of this study was age estimation based on sonography and X-ray findings of assessing fusion of ossification centres at lower end of humerus of patients and compares the accuracy of USG and X-rays in delimitation of age by means biostatistics.

This present study was carried out in the Department of Anatomy and Radio diagnosis, Index Medical College, Hospital and Research Centre Indore MP. We enrolled 300 cases for age estimation based on sonography and X-ray findings of fusion of ossification centres at lower end of humerus & compared it by their original age. Both male & female belongs to 14-20 years of age were studied.

In study of Panday K et al[8] the percentage of male subjects was higher in the age group of 18-19 years (Male-81.4%, Female-18.6%). However, females were higher in other age groups. William B, Sangma Ch, Marak FK, Singh SM[9] , in their study in northern India, concluded that by the age of 16 years, epiphysis around elbow joint fused completely. Binoy Singh TH[10] , in his similar study in 2007 had found that, at the age 18 years, there is complete fusion of epiphysis with diaphysis at elbow joints. Bhise SS, Nandkar SD[11] , in their study found, fusion of elbow at 14 to 15 years. Memchoubi PH[112] , in his similar study of radiological examination of elbow joint found that all the cases showed degree 3 fusion at the elbow joint at the age of 16 years.

In present study of 300 cases, majority of patients were in the age group of 15.1-16 years with more male patients than female (42.7% male & 35.3% female) and least were in 19-20 years (2.7% male & 6.0% female) (Table no 01).

Yasemin Bilgili et al[13] reported in their study 71.1% of male patients had the same age in both methods, and in 84.4% of patients, the difference was less than 6 months. In 65.5% of female patients, both methods revealed the same age, and in 88.5% of them, the difference was less then 6 months. In study we observed out of 300 cases, age of union of the medial epicondyle of humerus with shaft by USG and X-ray majority of patients were in the age group of 15.1-16 years. USG reported 63 (53.8%) patients more accurately than X-ray where X-ray reported 51 (43.6%) patients out of 117 **(Table no 02)**

Miyazaki CS et al[14] reported that the age ranges of the capitulum (0–1 year; 10–15 years), medial epicondyle (2–8 years; 13–17 years), trochlea (5–11 years; 10–18 years), olecranon (6–11 years; 13–16 years), and lateral epicondyle (8–13 years; 12–16 years) were, respectively, for appearance and fusion. And find Girls developed appearance and fusion earlier than boys do. In Nemade K. S et al[15] study reported epicondyle of humerus united with the metaphysis at 17 to 18 years in males and 15 to 16 years in females. Upper end of radius fused with the metaphysis at 17 to 18 years in males and 14 to 15 years in females. In our study out 300 patient age of union of the diaphysis of humerus with shaft by X-ray and USG majority 40 patients were in X ray and 39 (33.3%) in USG in age group 15.1-16 (117 patients) years and least 13 patients in X-ray & 13 in USG in age group 19-20 (13) years. **(Table no 04)**

CONCLUSION

1. Out of a total 100 cases, majority of patients were in the age group of 15.1-16 years (42.7% male & 35.3% female) and least were in 19.1-20 years (2.7% male & 6.0% female).
2. We found that over all USG was more accurate than X-ray.
3. Age of union of the medial epicondyle of humerus with shaft by USG and X-ray majority of patients were in the age group of 15.1-16 years. USG reported 42 (35.9%) patients more accurately than X-ray where X-ray reported 33 (28.2%) patients out of 117.

REFERENCES

1. Schmidt S, Koch B, Schulz R, Reisinger W and Schmeling A. Comparative analysis of the applicability of the skeletal age determination methods of Greulich-Pyle and Thiemann-Nitz for Forensic age estimation in living subjects. Int Leg Med. 2007; 121(4):293-296.
2. Reddy KSN. The Essentials of Forensic Medicine' and -Toxicology. Hyderabad: K.Saguna Devi;2008;27:64-74.
3. Krogman WM and Iscan MYF. The human skeleton in Forensic: Illinois: Charles C. Thomas, 1986;2:64.
4. Sangma W B, Marak FM, Singh M S and Kharrubon B. Age determinatiion in girls of North-Eastern region of India. Indian Acad Forensic Med. 2007;29(4): 101- 107.
5. Memchombi PH. Age determination of Manipuri girls from the radiological study of epiphyseal union around elbow, knee, wrist joints and pelvis. Indian Acad Forensic Med. 2006;28(2): 63-64.
6. Basu SK, Basu S. A contribution to the study of diaphyseo-epiphysial relations at the elbow of young Bengali girls. Indian Paed. 1938; 5:202-204.
7. Louise Scheur. Developmental juvenile osteology-page 6.

8. Panday K., Khan I, Prakash V, Mishra PP. Assessment of chronological age of individuals using radiological and ultrasonological means. International Journal of Contemporary Medical Research 2017;4(4):817-820.

9. William B, Sangma C, Marak FK: Age Determination in Girls of North – Eastern Region of India, JIAFM; 2007-29(4); 102 – 108.

10. Bijoy Singh T, Determination of Age of Majority of Manipuri Girls From The Radiological Examination of The Joints, Medicolegal update 2007, page no:04-06.

11. Bhise SS, Nanandkar SD, Age Determination From Radiological Study of Epiphyseal Appearance and Fusion Around Elbow Joint, JIFM, Jan-Jun 2013, Page No 24-32.

12. Memchoubi Ph, Age Determination of Manipuri Girls From the radiological Study of Epiphyseal Union Around the Elbow, knee, Wrist and Pelvis Joint, JIAFM. 2006; 28(2), 63-64.

13. Yasemin Bilgili, MD, Selda Hizel, MD, Simay Altan Kara, MD, Cihat Sanli, MD, Haydar Hüseyin Erdal, MD, Deniz Altinok, MD Accuracy of Skeletal Age Assessment in Children From Birth to 6 Years of Age With the Ultrasonographic Version of the Greulich-Pyle Atlas. J Ultrasound Med 22:683–690, 2003.

14. Miyazaki CS, Maranho DA, Agnollitto PM, Nogueira-Barbosa MH. Study of secondary ossification centers of the elbow in the brazilian population. Acta Ortop Bras. [online]. 2017;25(6):279-82.

15. Nemade K. S.1*, Kamdi N. Y.2, Meshram M. M. The Age Order of Epiphyseal Union around Elbow Joint - A Radiological Study in Vidarbha. International Journal of Recent Trends in Science And Technology, Volume 10, Issue 2, 2014 pp 251-255.