

AGE DETERMINATION FROM EPIPHYSEAL UNION OF BONES OF ANKLE JOINT IN GIRLS BY THE ROENTGENOGRAPH “GOLD STANDARD METHOD”

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Abstract

Introduction: In the underdeveloped and developing countries, where the documentation is not as per standard norm, there is an increasing demand or challenge for age estimation in living individuals for both anatomic and forensic contexts. Exact age is available from approved records only. It is important to examine whether the individual should have been considered as an adult or not. There are hundreds of ossification centers in the bones of the body but for assessment of age the long bones of upper and lower limbs play an important role. The epiphyseal fusion series usually starts at the elbow and through to the hip, ankle, knee, wrist, and eventually, the shoulder. Age data based on skeletal maturation appear in many articles, and the majority of criteria allow the observer to score whether the growth plate is fused, partially fused or fully fused. So, the present study was carried out to investigate the ages of epiphyseal union around the ankle joint and its correlation with chronological age. **Aims and Objectives:** To procure radiology films of ankle joint of both sides aged between 13 to 20 year girls from vidarbha region district and to assess whether the data correlate or contradict the findings of different authors in other parts of India. **Material and Methods:** The present Study was carried out in the department of radiodiagnosis at Jawaharlal Nehru Medical College in Collaboration with department of anatomy and Datta Meghe Medical College, Nagpur Maharashtra. Total 102 subjects' radiographs of the Girls aged between 13 to 20 years were included in the study. X ray film in A-P view was taken from the department of radiodiagnosis for the study. Skeletal maturity was evaluated as appearance, Non fusion (NF), Partial fusion (PF), and complete fusion (CF). **Results:** Non fusion was seen in 10 (9.80%) girls in 13-14 age group in both distal end of tibia and fibula. In 14-15 age group 11 (10.78%) girls X ray shows complete fusion at distal end of fibula while 9 (8.82%) and 2 (1.96%) show partial and complete fusion at distal end of tibia respectively. In 15-16 age group at distal end of fibula complete fusion was observed in 19 (18.63%) while complete fusion was observed in 19 (18.63%) at distal end of tibia. In 16- 20 age group 5 (4.90%) girls shows partial fusion at distal end of fibula while 57 (55.88%) shows complete fusion at distal end of fibula. In 16-20 age groups at distal end of tibia complete fusion was observed in 57 (55.88%) while partial fusion was observed in 5 (4.90%) i.e. 17-19 age group. **Conclusion:** The ossification at the ankle joint in females of vidarbha region completed in all subjects at the age of 15-20 year. To evaluate life style changes, studies are recommended in different regions of India at regular interval for academic and judicial interest.

Keywords--- Epiphyseal Union of Bones, Ankle Joint, Age Determination, Roentgenograph

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INTRODUCTION

In the underdeveloped and developing countries, where the documentation is not as per standard norm, there is an increasing demand or challenge for age estimation in living individuals for both anatomic and forensic contexts. Exact age is available from approved records only. It is important to examine whether the individual should have been considered as an adult or not. The important age determination methods are those of radiological anatomy and tooth morphological anatomy [1-3]. Bone epiphysis unites in different ages which are fairly stable for a specific epiphysis and this helps in deciding age [4]. In law the crime and punishment is based solely on criminal liability and depending on a person's age. It has been proved throughout the world that the study of epiphysal union of bones is considered a fairly reliable and established method as an age determination tool [5].

There are hundreds of ossification centers in the bones of the body but for assessment of age the long bones of upper and lower limbs play an important role. The epiphyseal fusion series usually starts at the elbow and through to the hip, ankle, knee,

wrist, and eventually, the shoulder. Age data based on skeletal maturation appear in many articles, and the majority of criteria allow the observer to score whether the growth plate is fused, partially fused or fully fused (6). Assessment for age of the bone the roentgenograph methods remain as the gold standard.(7) So, the present study was carried out to investigate the ages of epiphyseal union around the ankle joint and its correlation with chronological age.

AIMS AND OBJECTIVES

- To procure radiographs of ankle joint of both sides, aged between 13 to 20 years of female subjects of vidarbha region
- To examine the status of epiphyseal lines of bones and correlate the findings on the basis of previous studies.

MATERIAL AND METHODS

The present Study was carried out in the department of radiodiagnosis at Jawaharlal Nehru Medical College in Collaboration with department of anatomy and Datta Meghe Medical College, Nagpur Maharashtra. Total 102 subjects'

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radiographs of the Girls aged between 13 to 20 years were included in the study.

Inclusion criteria

- Girls aged 13 to 20 years

Exclusion criteria

- Any defect in the bones
- Any deformity or injury to the bone at ankle joint.
- Suffering from chronic disease which affects the general health.

Radiography

X ray films in A-P view were taken from the department of radiodiagnosis, Jawaharlal Nehru medical college and Acharya Vinobha Bhave Rural Hospital, Sawangi, (Meghe), Wardha for the study. An optimum voltage setting was done on 600 mA X-Ray machine to avoid unnecessary radiation exposure of the subjects. Skeletal maturity was evaluated according to the Jits and Kulkarnis [8] classification of three stages, appearance, non-fusion (NF), partial fusion (PF), and complete fusion (CF).

The chart was prepared and tabulated. Data analysis was done using Windows Excel 2013 software.

RESULTS

Table I. Age wise fusion (%) of distal end of Tibia and Fibula

Age in years	Distal end of Fibula						Distal end of Tibia					
	NF	%	PF	%	CF	%	NF	%	PF	%	CF	%
13-14	10	9.80	0	0.00	0	0.00	10	9.80	0	0.00	0	0.00
14-15	0	0.00	0	0.00	11	10.78	0	0.00	9	8.82	2	1.96
15-16	0	0.00	0	0.00	19	18.63	0	0.00	0	0.00	19	18.63
16-17	0	0.00	0	0.00	12	11.76	0	0.00	0	0.00	12	11.76
17-18	0	0.00	3	2.94	19	18.63	0	0.00	2	1.96	20	19.61
18-19	0	0.00	2	1.96	12	11.76	0	0.00	3	2.94	11	10.78
19-20	0	0.00	0	0.00	14	13.73	0	0.00	0	0.00	14	13.73
Total	10	9.80	5	4.90	87	85.29	10	9.80	14	13.73	78	76.47

NF: Non Fusion, PF: Partial Fusion, CF: Complete fusion

Non fusion was seen in 10 (9.80%) girls in 13-14 age groups in both distal end of tibia and fibula. In 14-15 age group 11(10.78%) girls X ray film shows complete fusion at distal end of fibula while 9(8.82%) and 2(1.96%) show partial and complete fusion at distal end of tibia respectively. In 15-16 age groups shows complete fusion at distal end of fibula in 19(18.63%) while at distal end of tibia complete fusion was observed in 19(18.63%) subjects. In 16- 20 age group 5(4.90%) shows partial fusion at distal end of fibula while 57(55.88%) subject shows complete fusion at distal end of fibula. In 16-20 age group complete fusion was observed in 57(55.88%) at distal end of tibia while partial fusion was observed in 5(4.90%) i.e.17-19 age group.

DISCUSSION

Data evaluated from the present study was compared with the similar studies from different part of the country as well as from the different parts of the world. Galstaun in 1937 showed 13-15 age of fusion of distal epiphysis of tibia in Bengali girls' population [9]. Bokariya et al (2009) observed age of fusion at distal epiphyseal union of tibia was 14-15[10]. Another study revealed from the central India by Patond et al. [11] age of fusion at distal epiphyseal union of tibia was 14-15. This is almost corresponding to our study i.e. the age of fusion at distal epiphyseal union of tibia seen in 15-16 year age group.

Davies and Parson (1927) in England showed age of distal epiphyseal fusion of fibula in females was 18 year [12]. Hepworth in 1929 observed age of fusion was 17- 18 in Punjabi population [13]. Galstaunin 1937 showed 13-15 age of fusion in girls in Bengali population [9] and Basu and Basu in 1938 also observed the age of fusion was 15 year [14]. In the present study age of fusion distal epiphyseal union of fibula in females is 14-15 year age group. Due to very narrow range of differentiation

between various stages of fusion, it is difficult to consider stage of fusion as age indicator. The exact opinion about age should always be given in the range. From the present study, range of 1-2 years of margin of error can be concluded.

CONCLUSION

Currently no data is available for assessment of time of fusion of epiphyseal lines for bones of ankle joint for vidarbha region. The presence of one more stage (partial fusion) between incomplete and complete stages of fusion provides furthermore defined age range estimations for the process of epiphyseal fusion at ankle. The ossification at the ankle joint in females of central Indians completed in almost 100% subjects at the age of 15-20 year. Due to changes in life style pattern, dietary habits, climatic changes, behavioral factors age of ossification is changing. So as to evaluate these changes, studies are recommended in different regions of India at regular interval for academic and judicial interest.

REFERENCES

1. Ubelacker DH. Estimating age at death from immature human skeletons: an overview. JForensic Sci1987; **32**: 1254-1263
2. Ritz S, Kaatsch HJ. Methoden der Altersbestimmung an lebenden Personen: Möglichkeiten, Grenzen, Zulässigkeit und ethische Vertretbarkeit. Rechtsmedizin1996; **6**:171-176.
3. Dharmesh SP, Harish A, Jigesh VS. Epiphyseal fusion at lower end of radius and ulna valuable tool for age determination. Journal of Indian Academy of Forensic Medicine 2011;**33**:31-35.
4. Aggarwal A. Ages of ossification-Personal Identification in Self-Assessment and Review of Forensic Medicine and

- Toxicology.1st ed. Delhi: Peepee Publishers and Distributers (P) Ltd.; 2006.p 51-59.
5. Banerjee KK and Aggrwal BB: Estimation of age from epiphyseal union at the wrist and ankle joint in the capital city of India. *Journal of Forensic science International*. 1998; 98: 31-39.
 6. Buikstra, J. E., Ubelaker, D. Standards for data collection from human skeletal remains. *Arkansas Archaeological Survey Research Series 44*. Arkansas Archeological Survey, Fayetteville, 1994.
 7. Vincenzo De Sanctis, Salvatore Di Maio, Ashraf T. Soliman, Giuseppe Raiola, Rania Elalaily, and Giuseppe Millimaggi: Hand X-ray in pediatric endocrinology: Skeletal age assessment and beyond; *Indian J Endocrinol Metab*. 2014 Nov; 18(Suppl 1): S63-S71
 8. Jit I, Kulkarni M. Time of appearance and fusion of epiphysis at medical end of clavicle. *Indian J Med Res*.1976 May; 64(5):773-82
 9. Galstaun G. A study of ossification as observed in Indian subject. *Indian journal of Medical Research*1937; 25(1):267-324.
 10. Pradeep Bokariya, D.S. Chowdhary, B.H. Tirpude, Ruchi Kothari, JE Waghmare, Aaditya Tarnekar, A Review of the Chronology of Epiphyseal Union in theBones at Knee and Ankle Joint, *J Indian Acad Forensic Med*. 2011;33:3:258-260
 11. Patond S, Tirpude B, Murkey P, Wankhade P, Nagrale N, Surwade V. AGE DETERMINATION FROM EPIPHYSEAL UNION OF BONES AT ANKLE JOINT IN GIRLS OF CENTRAL INDIA. *Journal of Forensic Medicine, Science and Law*. Vol 21, Number 2. (Jul- Dec 2012)
 12. Davies and Parsons, F G: The age order of the appearance and union of the normal epiphyses as seen by x-rays. *J. Anat*. 1927, vol. 62:58-71.
 13. Hepworth SM. Determination of age in Indians from study of the calcification of the long bones. *Ind Med Gaz* 1929; 64:128.
 14. Basu SK and Basu S. A contribution to the study of diaphysio-epiphysial relation at Knee of young Bengali girls. *Ind J of Ped* 1938; 5: 202-204.