

# Age Estimation among 12-18 Years Children by the Ossification Centers of Hip Joint and Pelvis.

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## ABSTRACT

**Background:** Age group of juveniles between 12 - 18 years were dealt with special laws for medical legal cases. After wrist and elbow joint, hip joint is the third most useful joint for estimation of age. Here in this study we have selected to estimate the age by analyzing the hip joint of juvenile within the age group of 12-18 years. **Methods:** A total of 72 patients were selected from various schools and colleges between the age group of 12-18 years. At Radiology department, X-ray of hip joint and pelvis of studied population was taken to study. **Results:** Triradiate cartilage ossification appeared in the age group of 12-13 years in most of the children, recent union observed mostly in the age group of 14-15 years. Ischial tuberosity appears by 15-16 years and fusion of epiphyseal center shown by 17-18 years. Iliac crest appeared in males and females by 13-14 years and completes its appearance by 15-16 years in females and 16-17 years in males. Pubis appeared by 13-14 years and completed by 16-17 years in both males and females. **Conclusion:** Age estimation by hip joint acts as a guide and a determining feature in age estimation and such a trend is of vast use in modern forensic anthropology. It can act as a supportive evidence for age estimation in the presence of other, more determinate and accurate, clues.

**Keywords:** Age estimation, Hip Joint, X-ray.

## INTRODUCTION

Age group of juveniles between 12 - 18 years were dealt with special laws for medical legal cases.<sup>[1]</sup> For forensic experts is a challenging task as a criminal responsibility for estimation of age. In India, most of the children especially those residing in rural areas are facing much problems related various dietary habits, social customs, multiple religions. Among children, dietary deficient in essential components like vitamins and minerals influence the growth of bones.

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After wrist and elbow joint, hip joint is the third most useful joint for estimation of age. The hip bone is the largest bone formed by three parts: ilium, ischium and pubis, which are separated by hyaline cartilage at birth. They join each other in a Y-shaped portion of cartilage in the acetabulum. Three regions will fused together by the end of puberty and they will ossify by the end of 25 years of age. The two hip bones join each other at the

pubic symphysis. Together with the sacrum and coccyx, the hip bones form the pelvis.<sup>[2]</sup>

Hip bone has eight ossification centers: three primary, one each for the ilium, ischium, and pubis, and five secondary, one each for the iliac crest, the anterior inferior spine, the tuberosity of the ischium, the pubic symphysis, and one or more for the Y-shaped piece at the bottom of the acetabulum.

In such a place where there is no availability of records related to records, much need for scientific methods determination of age which helps in identification of the person. Age determination can be done by various methods like general physical development, eruption of deciduous or permanent teeth, attainment of puberty, study of union of epiphyses with diaphyses and the suture closure. Here in this study we have selected to estimate the age by the analyzing the hip joint of juvenile within the age group of 12-18 years.

## MATERIALS AND METHODS

A prospective analytical study was done in the year 2013 for age determination by estimating the ossification centers of hip joint. The study was undertaken after taking institutional ethical committee approval at Department of Forensic

Medicine, Government Medical College, Anantapuram. Informed consent was taken from studied population and parents/guardians of children.

A total of 72 patients were selected from various schools and colleges between the age group of 12-18 years. 12-18 years of age group children were selected from different schools and colleges at Anantapuram, Andhra Pradesh.

Selected population exact age was confirmed by taking history related to birth dates or municipal corporation date of birth certificates or school records. All the studied population were screened for nutritional, developmental, and endocrinal abnormality which affects the skeletal growth, such children were excluded from the study.

At Radiology department, X-ray of hip joint and pelvis of studied population was taken to study. Ossification centers and fusion of bones were observed in all X-rays of every patient and graded according to sankhyan.<sup>[3]</sup>

Stage I -NA- Center has not appeared

Stage II - A - Center has appeared but there is no union

Stage III - + - Union has started but there is incomplete union

Stage IV - +++ - Recent union

Stage V - ++++ - Old union

After observation of skeletal maturity using X-rays by noticing appearance of ossification center and the fusion of bones in all patients, results were tabulated for better understanding.

## RESULTS

A total of 72 children were selected to analyze the age by notifying the ossification centers and fusion of the bones. Out of 72 children, 36 were female and 36 were male. 12-18 years age group studied population were divided into six groups, 12 children were in each group.

Triradiate cartilage ossification appeared in the age group of 12-13 years in most of the children, recent union observed mostly in the age group around 15 years. Ischial tuberosity appears by 15-16 years and complete union shown by 17-18 years [Table 1]. Iliac crest appeared in males and females by 13-14 years and completes its appearance by 15-16 years in females and 16-17 years in males. Pubis appeared by 13-14 years and completed by 16-17 years in both males and females [Table 2].

Head of the femur, greater trochanter and lesser trochanter all were united with the shaft by 17-18 years.

**Table 1: Ossification of Triradiate cartilage and ischial tuberosity among 12-18 years children.**

Bones	12-13 years		13-14 years		14-15 years		15-16 years		16-17 years		17-18 years	
	M	F	M	F	M	F	M	F	M	F	M	F
<b>Triradiate Cartilage</b>												
NF	0	2	0	0	0	0	0	0	0	0	0	0
+	3	3	1	2	1	0	0	0	0	0	0	0
++	3	1	5	4	4	5	4	4	0	2	0	0
+++	0	0	0	0	1	1	2	2	6	4	6	6
<b>Ischial tuberosity</b>												
NA	6	6	6	6	5	4	3	3	0	0	0	0
A	0	0	0	0	1	2	3	3	4	3	3	2
+	0	0	0	0	0	0	0	0	2	3	1	2
++	0	0	0	0	0	0	0	0	0	0	1	1
+++	0	0	0	0	0	0	0	0	0	0	1	1

**Table 2: Iliac crest and pubis ossification centers appearance among 12-18 years children.**

Bones	12-13 years		13-14 years		14-15 years		15-16 years		16-17 years		17-18 years	
	M	F	M	F	M	F	M	F	M	F	M	F
<b>Iliac crest</b>												
NA	6	6	5	5	2	5	1	0	0	0	0	0
A	0	0	1	1	4	1	2	3	0	2	0	1
+	0	0	0	0	0	0	3	2	5	4	5	5
++	0	0	0	0	0	0	0	1	1	0	1	0
+++	0	0	0	0	0	0	0	0	0	0	0	0
<b>Pubis</b>												
NA	6	6	4	5	2	2	0	0	0	0	0	0
A	0	0	2	1	4	4	5	3	2	1	3	4
+	0	0	0	0	0	0	1	3	4	4	1	1
++	0	0	0	0	0	0	0	0	0	1	2	1
+++	0	0	0	0	0	0	0	0	0	0	0	0

## DISCUSSION

Age estimation by radiographic examination of hip bone has a vast utility in forensic case work owing

to the wide acceptance of its accuracy as presented in various previous studies and thus, it can be concluded that the onset, progress, and fusion of ossification centers at hip bone is observed to be so

erratic, that it just provides a general pattern at the age levels which is mentioned in this study. Thus, it acts as a guide and a determining feature in age estimation and such a trend is of vast use in modern forensic anthropology.

It can act as a supportive evidence for age estimation in the presence of other, more determinate and accurate, clues. So the appearance and fusion of ossification centers may possibly be affected by nutritional and health status of the deceased, allometric growth, general growth and development of the bones, and to some extent by race. It may also be affected by exercise and physical activity of an individual. These factors may have possible and reasonable influences that could explain the variability observed in the age of appearance and fusion of ossification centers.

As per this study, Triradiate cartilage ossification appeared in the age group of 12-13 years in most of the children, recent union observed mostly in the

age group of 14-15 years. Ischial tuberosity appears by 15-16 years and fusion of epiphyseal center shown by 17-18 years. Iliac crest appeared in males and females by 13-14 years and completes its appearance by 15-16 years in females and 16-17 years in males. Pubis appeared by 13-14 years and completed by 16-17 years in both males and females. Head of the femur, greater trochanter and lesser trochanter all were united with the shaft by 17-18 years.

On comparison of the present study results with other studies [Table 3], correlates well with Singi yatiraj et al,<sup>[4]</sup> Alok kumar et al.<sup>[5]</sup> Singi yatiraj et al,<sup>[4]</sup> Bhise SS et al observed center fusion of ischial tuberosity at 16-17 yrs,<sup>[6]</sup> where as Alok kumar et al,<sup>[5]</sup> Galstaun et al reported little higher age group of 17-18 yrs. Galstaun et al noticed there is much earlier fusion of all hip and pelvis among females, about 14 years when compared to present study.<sup>[7]</sup>

**Table 3: Comparison of all studies in relation to hip and pelvis ossification centres.**

Ossification centres	Present study		Singi Yatiraj <sup>[4]</sup>		Alok kumar <sup>[5]</sup>		Galstaun <sup>[7]</sup>		Bhise SS <sup>[6]</sup>	
	M	F	M	F	M	F	M	F	M	F
Triradiate cartilage	F:15-16 yrs	F:14-15 yrs	F:16-17 yrs	F:15-16 yrs	F: 15-16 yrs	F: 15-16 yrs	F: 15-16 yrs	F:14 yrs		
Ischial tuberosity	A:15-16 yrs	A:15-16 yrs	A: 16-17 yrs	A: 15-16 yrs	A:17-18 yrs	A: 15-16 yrs	A: 16-18 yrs	A:14-16 yrs	A: 16-17 yrs	A: 15-17 yrs
Iliac crest	A:16-17 yrs	A:15-16 yrs	A: 16-17 yrs	A: 15-16 yrs	A: 16-17 yrs	A: 15-16 yrs	A:17 yrs	A:14 yrs	A:15-16 yrs	A:14-16 yrs
Pubis	A:16-17 yrs	A:15-16 yrs	A: 15-16 yrs	A: 15-16 yrs						

## CONCLUSION

From this study we conclude that Triradiate cartilage ossification appeared in the age group of 12-13 years in most of the children, union observed mostly in the age group of 14-15 years. Ischial tuberosity appears by 15-16 years and fusion of epiphyseal center shown by 17-18 years. Iliac crest and Pubis starts appearing mostly in the age group of 13-14 years and epiphyseal fusion observed by 15-17 years. Head of the femur, greater trochanter and lesser trochanter all were united with the shaft by 17-18 years.

It is necessary that more studies are conducted on modern populations worldwide by using standard methodologies and techniques so that more effective standards are drawn. There is a need to make careful investigations with due emphasis on the technical considerations proposed in the paper during this study to draw valid conclusions

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