

## AGES OF EPIPHYSIAL UNION AT THE ELBOW AND WRIST JOINTS AMONGST INDIAN GIRLS\*

By RAI BAHADUR RAGHUNANDAN LALL, M.B.  
Head of Department of Radiology, King George's  
Hospital, Lucknow

and

R. S. TOWNSEND, M.C., M.D., M.C.O.G.  
COLONEL, I.M.S.

Inspector-General of Civil Hospitals, North-West  
Frontier Province, Formerly Reader in Forensic  
Medicine, Lucknow University

THE work on which this report is based was carried out by the first writer in the radiological department of King George's Medical College,

It is difficult to define in a skiagram the point at which union may be said to be complete, but for our purpose an epiphysis was considered as definitely united only if the epiphysial space was, in bony architecture and density, indistinguishable from the epiphysis and diaphysis in its neighbourhood. Cases of recent union, where a thin line was still seen in the place of epiphysial cartilage, were classified as marginal cases.

We have divided the girls into eight age-groups of 10-11, 11-12, 12-13, 13-14, 14-15, 15-16, 16-17, and 17-18 years.

### Summary of observations

Our observations can be tabulated as follows:—

Number showing union in each age group

	Years							
	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Number of girls ..	17	7	6	18	21	19	17	20
Lower end of humerus	0	0	3	16	21	19	17	20
Medial epicondyle ..	0	0	3	14	19	19	17	20
Upper end of radius ..	0	0	0	10	18	19	17	20
Lower end of radius ..	0	0	0	0	3	9	10	13
Upper end of ulna ..	0	0	0	15	21	19	17	20
Lower end of ulna ..	0	0	0	0	5	9	10	13

Lucknow, at the suggestion of the second who was at one time reader in forensic medicine at the Lucknow University. The paper is complementary to that of Lall and Nat (1934).

The object of the investigation was to ascertain the ages of the union of epiphyses of Indian girls, as it is commonly believed that they unite at an earlier age than do those of European girls.

The skiagraphic method was thought to be preferable to the purely anatomical method of the study of the epiphysial union of long bones, as investigations could be carried out on a larger number of normal subjects whose ages were definitely known.

We had to face great difficulties in obtaining subjects for this work, on account of the *pardah* system, and also of the prejudices of parents. However, we managed to enlist the co-operation of three local girls' schools to supply the material, and we examined 125 girls of different communities, varying in age from 10 to 18 years. The total number of skiagrams taken was 250, both antero-posterior and lateral views being taken to make sure of the unions.

\* Rearranged by Editor.

The figures given in the table do not, however, easily lend themselves to generalization about the union of epiphyses, but, taking the age group of maximum increase in percentage of union and the youngest age group showing union of 90 per cent or over as criteria for our generalization, we may summarize the results of this investigation as follows:—

#### 1. Lower end of humerus.

Union takes place before the age of 15 years.

Considering the high percentage of union (90 per cent) one is justified in stating that union takes place mostly early in the 13-14 age group, that is, about the end of the 13th and the beginning of the 14th year.

#### 2. Medial epicondyle. Unites at 15 years.

3. Upper end of radius. Unites at 16 years.

4. Upper end of ulna. Unites at 15 years.

5. Lower end of radius and ulna. Unites at 19 years.

These results are at least about two years ahead of the figures given in various European textbooks of anatomy, and about a year ahead of the comparative figures obtained for Indian boys by previous research, carried out in this department (Lall and Nat, 1934).

Simultaneously, with the above radiological observations, we recorded the following data on the eruption of the teeth and onset of menstruation on the same cases. The results can be tabulated as follows :—

Age in years	Number of teeth erupted	Age in years	Number of teeth erupted
10-11	28	15-16	28-29
11-12		16-17	28-30
12-13		17-18	30-31
13-14			
14-15			

Out of the total number of 125 cases examined, 73 gave a history of the onset of menstruation as shown in the following table :—

Number of girls	Age of the onset of menses	Number of girls	Age of the onset of menses
6	11	17	14
13	12	9	15
27	13	1	16

From the above table we came to the conclusion that the menstruation starts in the majority of Indian girls between the ages of 12-14 years, and we also noticed that most of the girls examined showed signs of maturity at the age of 13 years.

*Discussion*

The calculation of age by radiography is not as accurate a science as lawyers and some doctors seem to think. What we are striving at is to get an approximate age for Indian girls from skiagrams which, together with puberty, teeth and general appearance, will enable us to give more accurate evidence of age in court.

Table showing the ages in years when union at the elbow and wrist joints occurs amongst Europeans and Indians

Parts	European standards	Indian boys	Indian girls
Lower end of humerus	16-17	15-16	14-15
Medial epicondyle ..	18	17	15
Upper end of radius ..	17-18	17	16
Upper end of ulna ..	16	16	15
Lower end of radius ..	20	19	19
Lower end of ulna ..	20	19	19

In 1936 in conjunction with his assistant, Rai Sahib Dr. Bhandari, the second writer drew up a table, summarizing the work done to date in India as regards the elbow and wrist joints. These joints have been chosen because more detailed examination of other bones is beyond the finances of an ordinary hospital; and also the examination of these joints can be carried out without undressing the children. These are important considerations in such an investigation.

Since this table was prepared the only Indian work on the subject is on 'Bengali Girls' by Basu and Basu (1938). We have incorporated these in the table below. It will also be noted that we have left out the head of the ulna. In our opinion this is one of the most difficult epiphyses in which to judge union, and there is such divergence of opinion by all authors that we have not been able to place reliance on it.

With regard to comparative figures given for England and America, we have taken anatomy books and x-ray specialist books on fractures, which are generally accepted as standard works on the subject. All have been quoted in the various Indian articles on this subject.

*Union of epiphysis with diaphysis at elbow joint and wrist joint*

Authority	Subjects	Lower end of humerus	Head of radius	Lower end of radius	Lower end of ulna
Cunningham ..	European	16-17	..	21	21
Gray ..	"	..	..	18-19	20
Frazer ..	"	17	..	22	20
Quain ..	"	16-17	..	..	..
Seudder ..	"	..	..	19-20	..
Spalteholz ..	"	17	..	..	..
Poland ..	"	..	..	19-23	18-20
Morris ..	"	17	..	20	20
Cohn ..	"	..	..	20-21	20-21
Buchanan ..	"	17	..	..	..
Ashhurst ..	"	15	..	..	..
Roberts and Kelly ..	"	20-22	..	..	..
Paterson ..	"	18-21	14-15	19	19
	males	14-15			
	females	14-15			
Sidham and Derry ..	Egyptians	17-18	17-18	18-19	18-19
Hepworth (1929) ..	"	14½	14-15	16-17	16-17
Galstaun (1930) ..	"	14	13-14	14-15	16
Raghunandan Lall and Nat (1934) ..	" girls, Bengal	17	17	19	19
Raghunandan Lall and Townsend ..	" boys, U. P.	15	16	19	19
Basu and Basu (1938) ..	" girls, Bengal	13-14	13-14	16-17	16-17

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## THE TITRE OF COMPLEMENT IN A SAMPLE OF HOSPITAL POPULATION IN CALCUTTA

By R. K. GOYAL, D.Sc., Ph.D., M.R.C.P., F.R.S.E.  
and

S. LAL, M.B., B.S.

(From the School of Tropical Medicine, Calcutta)

As there are no published records of the titre of complement in the blood of Indians, it was thought desirable to examine a series of apparently-healthy individuals. In this paper are recorded the results of the examination of 204 individuals of the type that attend a hospital out-patient department. The methods employed are summarized below. It was felt, however, that the estimation of complement without the determination of the hæmolysin present in the serum would give fallacious results and therefore hæmolysin present in each sample of serum was estimated.

**Technique.**—Three to four cubic centimetres of blood were drawn from the ante-cubital vein and kept in the incubator for 30 minutes, then left in ice-chest for three to four hours. The serum was separated, the complement titre and hæmolytic activity were then determined. A three per cent suspension of sheep cells and six

units of hæmolytic amboceptor were used. The test was put up as follows:—0.25 c.cm. of the serum under test, 0.25 c.cm. of the sheep-red-cell suspension and 0.5 c.cm. of normal saline. Sensitized red cells were used for the estimation of complement, the hæmolytic amboceptor was omitted in testing the hæmolytic property of the serum. The results were read after 30 minutes.

The complement titre was found to be equal to the hæmolytic titre in a certain percentage of cases, showing thus the absence of complementary activity of the serum as such. So the following calculation was adopted to determine the amount of complement as distinguished and free from normal hæmolysins. Complete lysis of red blood corpuscles with undiluted blood was taken as equivalent to one unit, a trace of lysis equalled 0.25 unit, partial lysis 0.5 unit and almost complete hæmolysis 0.75 unit. In this way, almost complete hæmolysis by 1 in 12 dilution of serum could be expressed as the serum containing 11.75 units. It was thus possible to deduct the hæmolytic figure from the complement figure and state the amount of corrected complement in a particular case.

In referring to the complement, we would mention data regarding corrected complement only unless otherwise stated.

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**Summary.**—(1) In India, estimating the age of adolescents has only in the last few years been determined by *x*-raying epiphysial union.

(2) The subject, especially in females, has great medico-legal importance. No Indian medico-legal textbook has published any authoritative tables.

(3) Investigations at present published are confined to Bengalee and United Provinces girls.

(4) The number of cases examined so far are too few to generalize upon.

We can, however, say that the Indian girl is at least a year ahead of European girls in development between the ages of 10 and 20 as far as bony union is concerned.

We wish to thank the Lucknow University for placing at our disposal the means to carry out this work, and also Dr. A. P. Verma, who, as Kunwas Inderjit Singh's research scholar, has rendered valuable assistance.

We are hoping that this article will reach a wider circle of readers than the previous article in the *Indian Journal of Medical Research*. We apologize to any authors whose work on the subject has passed unnoticed.

### REFERENCES

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TABLE

	Number of cases	Percentage distribution						
		Negative	Dilutions					
			0	2	4	8	12	16
Complement	204	1.5	0.5	22.5	58	12.7	2.9	1.9
Hæmolysin	204	8.3	8.3	40	41	2.4	..	..

It will be seen from the table that titre of complement present in the blood of hospital class Indians is somewhat lower than the figure obtained in Europe and America. In a series of 204 Indians, the average amount of serum to produce complete lysis of sensitized red cells was 0.06 c.cm. (range between 0.0156 c.cm. to 0.33 c.cm.), 1.5 per cent cases had no complement (uncorrected) in 0.25 c.cm. of the serum. The average amount of corrected complement was 0.147 c.cm. with a range between 0.017 to 1 c.cm. in positive cases. No complement could be demonstrated in 0.25 c.cm. of undiluted serum in 40.7 per cent cases. Hadjopoulos and Burbank (1928) examined a series of two thousand apparently-normal Americans; the average hæmolytic complementary titre was found to be represented by 0.04 c.cm. of active serum. Veil and Buchholz (1932) found the complement titre of normal blood in central Europe to range between 0.02 c.cm. and 0.06 c.cm. with an average volume of 0.05 c.cm. A similar titre was found by Tilden (1935) in America. Sera from a small series of (seven) apparently-healthy middle-class Indians gave a