Original Article

AGE DETERMINATION OF FEMALE SPORT PERSONS OF AGE 9-18 YEARS BY RADIOLOGICAL EXAMINATION OF ELBOW AND WRIST JOINT

Dr. RC. Dere, Dr. HG. Kukde, A. Maiyyar, Dr. SV. Dhoble

Authors

Dr. Rajesh C. Dere, Professor (Adl), Department of Forensic Medicine & Toxicology, LTMMC, Sion, Mumbai.

Dr. Hemant G. Kukde, Assistant Professor, Department of Forensic Medicine & Toxicology, LTMMC, Sion, Mumbai.

Amol Maiyyar, Assistant Professor, Department of Forensic Medicine & Toxicology, GMC, Nagpur.

Dr. Shashikant V. Dhoble, Junior Resident, Department of Forensic Medicine & Toxicology, LTMMC, Sion, Mumbai.

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Address for correspondence: Dr. Rajesh C. Dere, Professor (Adl), Department of Forensic Medicine & Toxicology, LTMMC, Sion, Mumbai.
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Abstract

Scientific estimation of age of an individual whether living, recently dead person, disintegrated and decomposed dead bodies, skeletal remains or incomplete skeleton or fragmentary remains is vexing problem for medical jurist, in both civil and criminal cases and is an important part of examination in medicolegal practice. Cheating often occurs in sports that are defined by age when older participants compete by falsifying their true age by measuring the skeletal age of competitors.

Present study was carried out to determine age in female sports person of age 9 to 18 years by radiological examination of elbow and wrist joints.

Thirty eight female sports persons were examined and X ray examination of elbow joint and wrist joint was carried out.

In females, fusion of ossification centres of elbow joint occurs by 14 – 15 years, ossification centres of lower end of radius and ulna fused by 17 – 18 years and ossification centres of pisiform appeared by the 10 – 11 years.

Key Words: Epiphyseal union, sports, ossification centres, elbow joint, wrist joint, radiological examination.

Introduction:

Determination of age of an individual from the appearance and the fusion of the ossification centres is a well accepted fact in the field of medical and legal profession. Epiphysis of bones unite during age periods which are remarkably constant for a particularly epiphysis. This is possible due to complex but dependable system by which the osseous framework of the body develops, grows and matures. Epiphysis of the bones unites at particular age and this is helpful in age determination (1).

Age is one of the significant primary characteristics in identification of an individual and has considerable medicolegal importance in administration of justice. The incidence of age cheating in sports has increased and has caused a problem comparable to athletes taking illegal substances. Identity documents pr birth certificates cannot be used with confidence to identify age, particularly in developing countries (2, 3).

Objective: To determine age in female sports person of age 9 to 18 years by radiological examination of elbow and wrist joints.

Method: Study was conducted in 38 female subjects. These subjects were female sports person coming for medical age determination sent by various State Sports Association approved by Sports Authority of India in State of Maharashtra belonging to Schools, Colleges of different cities, predominantly of western Maharashtra. The selection of the subjects was based on the following criteria:
Inclusion criteria:
  a) All the subjects should have exact documented record for date of birth.
  b) Informed written consent with full disclosure, of each subject to be taken before proceeding for radiological examination.
  c) No evidence of malnutrition or other diseases that would affect the skeletal growth and general development of person.
  d) All the subjects should have good hygiene and normal physique.

Exclusion criteria:
  a) Subjects having congenital and acquired anomalies.
  b) Subjects with nutritional and endocrinal deficiencies.
  c) Subjects those who come for age determination, other than sports persons.
  d) Pregnant female.
  e) Subjects whose date of birth is not known.

Methodology:
• Permission of institutional ethical committee is obtained by submitting the study project.
• Subjects are selected according to criteria mentioned above.
• Informed consent of subject obtained prior to examination.
• Radiological assessment for fusion or no fusion of ossification centre of wrist joint and Elbow joint.
• General and physical examination was done in Department of Forensic Medicine And Toxicology, Lokmanya Tilak Municipal Medical College & General Hospital, Sion, Mumbai.

Each of these subjects was radiographed for the elbow joint, wrist joint pelvic with iliac crest and mandible in the Department of Radiology, LTMMC & LTMGH, Sion, Mumbai by digital method. This includes following radiographs.
  1. Elbow joint PA and lateral view: Showing Medial Epicondyle, Lateral Epicondyle, Capetulum, Trochlea, Conjoint Epiphysis, Upper End of Radius and Ulna.
  2. Wrist joint PA lateral view: Showing Lower End of Radius and Ulna, Carpal Bones and Base of 1st Metacarpal.

Observations:
Out of 38 female subjects, 70 % belong to age group of 12 to 15 years followed by age group 10 to 11 years. 33 out of 38 subjects belong to middle economic class and 5 belong to high socio-economic status. For determination of appearance and fusion of ossification centres in elbow and wrist joints, subjects are grouped on the basis of age groups as from 9 years to 18 years:

X ray elbow joint:
Present study observed that Capitulum and Medial Epicondyle appeared in all cases. Trochlea and lateral Epicondyle appeared in most of the cases, 30 (78.9%) at the age of 11 to 14. Ossification centres of lower end of elbow found to be fused in 12 (31.5%) by conjoint epiphysis at the age of 14 to 15 years. (Table 1)

X ray elbow joint Lower end of humerus:
The ossification centres of Lower end of humerus with shaft found to be fused at the age of 14 years in 9 (23.68%) case and 13 to 15 years in 20 (52.6%) cases. (Table 2)
X ray wrist joint Lower End of Radius And Ulna:
In female the lower end of radius and ulna of wrist joint found to be appeared appeared in all 38 (100%). Lower end of radius found to be fused in 21 (55.2%) at the age of 18 years followed by 14 (36.8%) at the age of 17 years. At the age of 17 to 18 years, total 25 (65.78%) show union at lower end of radius. Lower end of ulna show fusion at the age of 18 years in 24 (63.1%) and 10 (26.3%) cases. most of the cases, 24 (63.15%) is in between 17 to 18 years of age. (Table 3)

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Radius Appeared</th>
<th>Radius Fused</th>
<th>Ulna Appeared</th>
<th>Ulna Fused</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>10</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>11</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>12</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>13</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>14</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>15</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
<td>38 (100%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>16</td>
<td>38 (100%)</td>
<td>3 (7.8%)</td>
<td>38 (100%)</td>
<td>4 (10.5%)</td>
</tr>
<tr>
<td>17</td>
<td>38 (100%)</td>
<td>14 (36.8%)</td>
<td>38 (100%)</td>
<td>10 (26.3%)</td>
</tr>
<tr>
<td>18</td>
<td>38 (100%)</td>
<td>21 (55.2%)</td>
<td>38 (100%)</td>
<td>24 (63.1%)</td>
</tr>
</tbody>
</table>

Table No 3.

X ray wrist joint Base of First Metacarpal and Pisiform:
In female wrist joint base of first metacarpal most frequently found to be appeared at the age of 14 and 15 years in 17 (44.7%) and 12 (31.5%) cases respectively while pisiform was found to appear most commonly at the age of 11 and 12 years in 10 (26.3%) and 15 (39.4%) cases respectively. (Table 4)
<table>
<thead>
<tr>
<th>Age in years</th>
<th>Base of First Metacarpal</th>
<th>Pisiform</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appeared</td>
<td>Fused</td>
</tr>
<tr>
<td>9</td>
<td>38</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>10</td>
<td>38</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>11</td>
<td>38</td>
<td>1 (2.6%)</td>
</tr>
<tr>
<td>12</td>
<td>38</td>
<td>2 (5.2%)</td>
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<tr>
<td>13</td>
<td>38</td>
<td>4 (10.4%)</td>
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<tr>
<td>14</td>
<td>38</td>
<td>17 (44.7%)</td>
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<tr>
<td>15</td>
<td>38</td>
<td>12 (31.5%)</td>
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<td>16</td>
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<td>2 (5.2%)</td>
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<td>17</td>
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<td>0 (0.0%)</td>
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<tr>
<td>18</td>
<td>38</td>
<td>0 (0.0%)</td>
</tr>
</tbody>
</table>

Table No 4.

Discussion:

Age determination by epiphyseal fusion is one of the most important scientific tools in Forensic Medicine. In this study, main emphasis is given on time of fusion of epiphysis with diaphysis.

William B, Sangma Ch, Marak FK, Singh SM\(^1\), in their study in northern India, concluded that by the age of 16 years, epiphysis around elbow joint fused completely. Binoy Singh TH\(^4\), 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\(^8\), in their study found, fusion of elbow at 14 to 15 years. Memchoubi PH\(^10\), 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. Memon N, Muhammad UM, Memon K, Junejo H, Memon J\(^11\) in their similar study, found that fusion of epiphysis in females is completed by the age of 14-15 years. In this study it was observed that epiphysis of lateral epicondyle and trochlea appeared by 11 to 14 years. However, fusion of the elbow occured by 13 to 14 years for majority of the cases. Comparing the bove studies, it was observed that fusion around elbow by and large are similar with studies done by Bhise SS, Nandkar SD, Memchoubi Ph, Memon N, Muhammad UM, Memon K, Junejo H, Memon J. This similarity of fusion of elbow joint in female can be attributed to the same study sample group i.e. the urban population in all above similar studies.

William B, Sangma Ch, Marak FK, Singh SM\(^1\), in their study in northern India found that in wrist joint complete union occurs at 18 years. Davies and Parsons (1927)\(^5\) in their study in England found that distal end of radius fuses at 19-20 years. Distal end of ulna fuses at 20 years. Dharmesh S. Patel, Harish Agarwal, Jigesh V. Shah\(^6\), in their study in 2011 found that starting up of epiphyseal appearance in lower end of ulna of both hand for female is 16-17 years. And completion of epiphyseal fusion in lower end of ulna of both hands in female is 18-19 years. Hepworth SM (1929)\(^7\) in his study in Punjab found that distal end of radius fuses at 16-17 years in both sexes. Distal end of ulna fuses at 16-17 years. Memchoubi PH\(^10\) in his study observed that elbow fused by the age of 17 years. In this study lower end of radius and ulna are found to be fused by 17 to 18 years. The present study corroborated with the observations made by William B, Sangma Ch, Marak FK, Singh SM\(^1\) and Memchoubi PH\(^10\).

Davies and Parsons (1927)\(^5\) in their study in England found pisiform appears at 12 years. Shrivastav A, Saraswat PK, Agarwal SK and Gupta P\(^9\) in their study found that
pisiform appears at the age of 11-12 years. In this study, it is found that pisiform appears at 10 to 11 years. Base of 1st metacarpal fuses by 14 to 15 years in females.

**Summery And Conclusion:**

Study was conducted in 38 subjects. These subjects were Sports person coming for age estimation sent by various recognized state associations by Sports authority of India in State of Maharashtra. These sports persons belong to schools, Colleges of different cities of State of Maharashtra. Subjects between the age group of 9 to 18 years were taken into consideration, as this age group is significant with regards to medicolegal aspect.

From observation and discussion in study following specific scientific conclusions are drawn:

- In this study, it was found that epiphysis of lateral epicondyle and trochlea appeared at 11 to 14 years in females. However fusion of the same occurs at 14 to 15 years for females.
- In this study, lower end of radius and ulna are fused by 17 to 18 years in female. Pisiform bone appears at 10 to 11 years, base of 1st metacarpal fuses by 14 to 15 years.
- There is no significant correlation between socioeconomic status and skeletal maturation or epiphyseal fusion.

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