



ANTHROPOMETRIC ANALYSIS OF ELBOW JOINT AMONG SOUTH INDIAN POPULATION USING DIGITAL RADIOGRAPHS

Orthopaedics

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ABSTRACT

Aim & Objectives: The aim of this study is to evaluate the normal radiological parameters of the elbow joint in the South Indian population.

Materials & Methods: This study conducted at Coimbatore Medical College Hospital in the Institute of Orthopaedics and Traumatology. Standard normal radiographs of 120 patients belonging to all ages and both sexes were collected from the radiological department.

Results: Several statistically significant differences based on age and sex were noted, but were small and not found to be clinically significant with exception of an increased carrying angle in females

Conclusion: Knowledge about the normal radiographic anatomy of the elbow joint can help the Orthopaedic surgeons in attaining perfect reduction during treatment of elbow fractures and also useful in designing prosthesis for elbow arthroplasty.

KEYWORDS

Elbow, Carrying angle, Baumann's angle.

INTRODUCTION:

Elbow joint is a complex hinge joint made of 3 bones namely the distal end of humerus and proximal ends of radius and ulna. Historically, only limited data is available to describe the normal radiographic anatomy of elbow joint. All the available literature focuses primarily on the fracture outcomes[1][2][3][4], ossification patterns[4] and gender differences[5]. Understanding the radiographic anatomy of the joint is important in evaluating abnormalities such as osteonecrosis of capitulum, osteochondral defects, and medial apophysitis etc.

The purpose of this study is to evaluate the normal radiographic anatomical parameters in the elbow radiographs both in antero-posterior and lateral views using simple methods so as to enable the operating Orthopaedic surgeon to achieve good restoration of the normal anatomy intra-operatively and hence a normal functional joint post-operatively.

MATERIALS AND METHODS:

This study was conducted at Institute of Orthopaedics and Traumatology, Coimbatore medical College Hospital from the period of January 2019 to July 2019. The standard antero-posterior and lateral radiographs of the elbow joint of 120 normal subjects were collected from the radiology department. Patients were in the age group of 3 to 60 years which included males and females. The bone age was used to differentiate age groups. Skeletally immature subjects with open physis were taken as adolescent group and skeletally mature subjects were taken as adult group. All patients belonged to South Indian origin and ethnicity. By using digital x-rays the following parameters were measured.

Measurements in the Antero-Posterior radiograph:

- 1) **Radial Neck shaft angle** – The angle was measured between a longitudinal line drawn along the radial shaft and a longitudinal line drawn perpendicular to the articular surface of the radial neck. The normal value previously reported was: 15 degrees.
- 2) **Carrying angle** – This angle was measured between the a longitudinal line drawn along the shaft of the ulna and longitudinal line drawn along the axis of the humeral shaft. Previous reported normal values: 10-15 degrees in males and 15-20 degrees in females. Carrying angle is positive in valgus alignment.
- 3) **Baumann's angle** – Pediatric age group with an open physis were used to measure this angle. It was measured between a line along the open capitellar physis and a longitudinal line drawn along the shaft of humerus and. Previously reported normal values

were: 64-82 degrees in males and 69-81 degrees in females.

- 4) **Articular surface angle** – This angle was measured between a transverse line drawn along the most distal aspect of the bony trochlea and the capitellum and the longitudinal axis of the shaft of humerus. Previous reported normal values were: 82-84 degrees.

Measurements on Lateral radiographs:

- 1) **Olecranon - coronoid angle** – This angle was drawn between a line drawn along the olecranon tip and coronoid tip and longitudinal line drawn along the long axis of the ulna. Previous repeated normal value: 30 degrees; in males – 22.3 degrees, in females – 14.7 degrees.
- 2) **Anterior angulation of Articular surface of Distal Humerus** – This angle was measured between a line bisecting the capitellum and a line drawn along the humeral shaft. Previous reported normal value: 30 degrees.
- 3) **Anterior Humeral- Capitellar line** – A longitudinal line was drawn along the anterior surface of the distal humerus and continued distally to pass through the capitellum. The relationship with the capitellum was recorded as central $1/3^{\text{rd}}$, anterior $1/3^{\text{rd}}$ or posterior $1/3^{\text{rd}}$. Previous reported normal value: Central $1/3^{\text{rd}}$.

RESULTS:

Totally 120 normal subjects were included in the study. The standard antero-posterior and lateral elbow radiographs were collected and analysed. There were 68 males and 52 females included in the study. Based on bone age, 22 adolescents and 98 adults were studied. The results were tabulated.

Measurements in AP radiograph

Antero-posterior radiographic measurements are calculated by both bone age group and by sex group separately. While assessing bone age with each AP radiograph measurements, increasing bone age was associated with increase in articular surface angle.

Baumann's angle was measured only in young adolescents with open physis (n=22; 14 males and 8 females). This measurement did not differ between sexes.

While comparing the both sexes radial neck shaft angle and articular surface were higher in females than the males. There was no significant difference in the carrying angle while comparing both sexes.

**FIG: 1**

- carrying angle
- radial neck shaft angle
- articular surface angle

Measurements in Lateral radiograph

Measurements made in the lateral radiograph are evaluated by both bone age group and sex separately. There was no significant differences in the anterior angulation or olecranon coronoid angle while comparing the male and female groups.

While comparing the bone age groups the open physis group (n=22) had increased anterior angulation of the articular surface of humerus while compared to the adults. This implies that anterior angulation of articular surface of humerus decreases with increasing age. Also the olecranon coronoid angle seems to decrease significantly with increasing age.

There were no significant differences in anterior humeralcapitellar line by bone age group or by sex.

**FIG: 2**

- anterior humeralcapitellar line
- olecranon coronoid angle
- anterior angulation of articular surface of distal

DISCUSSION:

The anterior humeral- capitellar line is most commonly utilized to assess sagittal alignment of the distal humerus in the setting of a supracondylar humerus fracture, and is typically described as normal when the anterior humeral line intersects the middle of the capitellum. In previous studies, the anterior humeral line intersected the capitellum in the middle third in most of the older group but in the anterior or middle third in the younger group[6].

Carrying angle is a useful parameter in cases of distal humerus malunion and elbow instability, among other conditions. We did not find a significant difference based on age. While we did confirm a statistically distinct difference between males and females; the 2-degree higher carrying angle in females is a minimal clinical difference.

Rettig et al[7] provided additional objectivity to the assessment of the radial- capitellar line by using a circular template on the capitellum to directly quantify alignment of the radial head and the capitellum.

There are several weaknesses to this investigation. We used plain radiographs to assess the adolescent elbow, recognizing that the youngest children in this series continue to have a significant cartilaginous contribution to the elbow anatomy. Most notably, this may affect our assessment of olecranon- coronoid angle and our subjective assessment of articular contour. Nonetheless, given the fact that most clinical assessments are based on plain radiographs, we feel our techniques are reasonable. Finally, standardization of radiographic technique affects measurement precision.

CONCLUSION:

The radiographic assessment of the adolescent and young adult elbow is challenging due to a lack of objective, reliable measurement tools and the cartilage of the skeletally immature elbow. Most measurements were consistent between males and females and across the age spectrum; even statistically significant differences may not be clinically important. The new assessment of the distal humerus articular surface (both subjective and objective assessments) demonstrated an increased contour with maturity. Knowledge about the normal radiographic anatomy of the elbow joint can help the Orthopaedic surgeons in attaining perfect reduction during treatment of elbow fractures and also useful in designing prosthesis for elbow arthroplasty. Restoration of these parameters to the normal range in the injured limb can result in good functional outcome of the limb clinically.

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