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THE NORMAL CARRYING ANGLE OF THE ELBOW IN SHIRAZ

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ABSTRACT

The normal carrying angle in Shiraz population was measured on the basis of sex and age. The right elbow angle of 4266 cases was examined from birth to 30 years old. This study found the carrying angle in 2540 females to be 7.2° (range 2-19) and in 1726 males to be 6.4° (range 2-11), a 0.8° difference.

A significant difference (p= 0.05) was found in relation to age. There is a gradual increase in the carrying angle with skeletal maturation.

Keywords: Angle, Elbow.

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INTRODUCTION

The carrying angle can be considered to be formed by the long axis of the forearm and the long axis of the humerus in the frontal plane.[1,2,6] The carrying angle of the elbow is generally regarded as being greater in females than in males and is considered to be a secondary sex characteristic. Supporting evidence for this concept was provided by the clinical observation of Baughman et al.[2]

The carrying angle varies linearly as a function of flexion. In extension, there is a valgus angulation. The carrying angle is most apparent when the elbow is straight and the forearm fully supinated.[1,3,5]

Potter (1905) probably is the first who published measurements of the carrying angle in 185 adult cases. He found the mean carrying angle in 90 women to be 12.6° and in 95 men to be 6.8°, a difference of 5.8°.[1-3]

Baughman et al. in a clinical study found the carrying angle in 50 women to be 15° (range 2-26[2]) and in 50 men to be 11° (range 2-21), a 4° difference.

Beals measured the carrying angle of 422 patients in a recent study and found a mean carrying angle of 15° in the 4-6 year old age group and 17.8° in adults.[3] He found no significant difference between males and females.

PATIENTS AND METHODS

From Oct. 1994 to Feb. 1996 the carrying angle of the elbows of 4266 cases were measured. 2540 were females

Table I. Subject distribution according to age and sex.

Age group	Male	Female
0-1	50	91
2-3	103	159
4-6	162	262
7-12	409	496
13-15	260	254
16-20	250	427
21-25	230	422
26-30	262	429

Table II. Minimum and maximum carrying angle values in males according to age.

Male group	Minimum	Maximum
0-1	2.00	6.00
2-3	2.00	5.00
4-6	3.00	7.00
7-12	4.50	8.00
13-15	3.00	9.00
16-20	5.00	11.00
21-25	5.00	11.00
26-30	5.00	11.00
Total	2.00	11.00

Table III. Minimum and maximum carrying angle values in females according to age.

Female group	Minimum	Maximum
0-1	2.00	7.00
2-3	2.50	7.00
4-6	3.00	8.00
7-12	5.00	11.00
13-15	5.00	10.00
16-20	5.00	19.00
21-25	6.00	13.00
26-30	5.00	13.00

and 1726 were males aged from birth to 30 years old.

Subjects were divided in to 8 groups on the basis of age and sex (Table I). Randomized sampling was performed and the number of each group was determined by an epidemiologist.

The cases of the first group of both sexes were chosen from nurseries of medical university hospitals. Cases aged 2-6 years old were selected from five babysitter institutes and kindergartens in Shiraz. Cases aged 7-12 years old were selected from elementary schools. Cases aged from 13-15 years old were chosen from junior high schools and cases aged from 16-20 years old were picked-up from high schools. Cases above 20 years old were chosen from students of medical and nursing faculties.

For precise measurement, we made 3 reference points on the upper limb. The proximal point is the medial border of the acromion, the midpoint of the transverse cubital crease is the second point, and the midpoint of the volar wrist crease is the third point. Lines drawn through these points established the carrying angle, and the angle was measured with a unique standard goniometer.

Table IV. Mean and SD of the carrying angle among male subjects.

Group (Male)	No.	Mean angle	Standard deviation
1	50	3.6000	.9422
2	103	3.5971	.6898
3	162	4.7593	1.1328
4	409	5.8165	.7060
5	260	6.4563	1.0392
6	250	7.7600	1.1169
7	230	7.2826	0.8244
8	262	7.5038	1.1866
Total	1726	6.4627	1.7350

RESULTS

This study measured the carrying angle of the right elbow of 4266 cases. The mean, two standard deviations, the 95th percentile, and range were determined for each group and sex. No significant differences were found between males and females in any age group.

There is a gradual increase in the carrying angle with skeletal maturation. A significant difference (p= 0.05) was found in relation to age except for the first and second group of each sex. The mean carrying angle in 2540 females was found to be 7.2° (range 2-19) and the mean carrying angle in 1726 males 6.4° (range 2-11), a 0.8° difference (Tables II-V).

DISCUSSION

Most previous studies have focused on the question of

Table V. Mean and SD of the carrying angle among female subjects.

Group (Female)	No.	Mean angle	Standard deviation
1	91	3.7143	1.0059
2	159	3.8553	.7534
3	262	5.2481	1.0337
4	496	6.7611	.9550
5	254	7.2992	1.1648
6	427	8.3302	1.5911
7	422	8.7109	1.0636
8	429	8.7156	1.4415
Total	2540	7.2856	1.9999

differences in sex, and little attention has been given to the effect of age.[1,3,4,8] Smith measured clinically the carrying angle of 80 girls and 70 boys. Baughman et al. measured the carrying angle of 50 women and 50 men and Keat measured it in 25 women and men.[2,4,8]

Beals found an average carrying angle of 17.8° in adults. Keats found this angle to be 13° in women and 11° in men. Baughman et al. reported 15° in women and 11° in men.[2-4]

Potter found a a sex difference of 5.8°. Steel and Tomlinson found a difference in the carrying angle of 0.9°, and Aebi reported a difference of 6.4°, an even greater difference than that reported by Potter.[1-4,7,8]

Baughman et al. found the range of the carrying angle in men to be 2-21°, and in women 2-26°. Keats found this range to be 2-26° in men and 2-22° in women.[2-4]

The present study is a statistical randomized sampling of measurements of the carrying angle of 4266 cases on the basis of age and sex. The average carrying angle in our study was 7.2° (range 2-19) in 2540 females and a mean of 6.4° (range 2-11) in 1726 males, with a difference of 0.8°. This value is less than that reported in other studies, but the sex difference of this study is less than the majority of reports.[1-4,6-8] The apparent sex difference is explained by increased joint laxity in females, permitting hyperextension.[2,3,5,6]

The carrying angle results from the configuration of the humero-ulnar articular surfaces and ligament constraints.[5,6] Thus the anatomy of this joint in this population has some differences and ligament laxity is less compared to other reports.

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