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Radiological evaluation of the acromioclavicular joint

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Abstract. X-ray measurement of the acromioclavicular (AC) joint may cause difficulties because of different projections and the lack of a reproducible measurement. In order to find the ideal measurement to estimate the state of the AC joint, 28 healthy adult volunteers were X-rayed. The least vulnerable measurement for errors in projection was the distance between the coracoid process and the upper part of the clavicle. The effect of stress was evaluated; the range of normal AC joint laxity was determined as 3 mm.

Key words: Acromioclavicular joint – Radiological evaluation – Measurement – Normal acromioclavicular laxity

The acromioclavicular (AC) joint is a diarthrodial joint between the lateral end of the clavicle and the medial side of the acromion. It is supported by strong ligamentous structures – the AC ligaments around the articulation and the coracoclavicular ligaments on the medial side of the joint.

The normal AC joint space has been considered to be no wider than 7 mm in men and 6 mm in women [4]. However, there are differences in alignment between the lower edge of the clavicle and the acromion. Pettrone and Ninschl found that in 81% of subjects there was alignment between the lower edges of the clavicle and the acromion [5].

The coracoclavicular distance and the AC joint space are the most important features in determining luxation or subluxation. Proposed normal values for the coracoclavicular distance are 8–13 mm, [1, 3] and for the AC joint space, 3–4 mm [1, 7].

The coracoclavicular ligaments are significant restraints against upward dislocation of the clavicle [6]. The ligament is an important stabilizer of the clavicle for posterior motion [2].

X-ray evaluation of the AC joint is problematical and may cause difficulties because of different projections and the lack of a constant measure. In order to find the ideal measurement for assessing the AC joint and to define its normal values, we studied a normal population by X-radiography examination.

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Materials and methods

Radiography of both AC joints of healthy volunteers (mean age 27 years, range 21.6–33.2 years) was undertaken using a wide plain film (Agfa Curix RP 1, intensifying screen Agfa Curix MR 400). The film-focus distance was 2 m and the focus was centered from an anterior-posterior direction on the jugular vein; a horizontal beam technique was employed. The patient's position was standardized as erect with both scapula and occipital area of the skull close to the cassette. Radiographs were taken during full inspiration, and patients were asked to relax their shoulders as much as possible. Radiographs were repeated after a while by another radiographer. Five different measurements (Fig. 1) were taken from each radiograph. Two investigators measured these distances on two occasions and the mean value, standard deviation, and variance were calculated. The difference (%) of the two radiographs was calculated for each measure.

In order to examine laxity of the normal AC joint, 28 healthy adult volunteers were studied. Radiographs were taken with and without stress. The patient's position and the radiograph technique were standardized. Stress was induced in the vertical position by hanging 5-kg (body weight below 75 kg) or 7.5-kg (body weight over 75 kg) weights on both wrists. Because of errors, a total of 16 radiographs were acceptable to study all 32 shoulders. The mean age of the patients was 35.6 years (range 18.1–50.5 years). The measurements were determined twice each by two investigators.

In addition, the thickness of the lateral end of the clavicle, clavicular torsion, and the AC joint space were measured. For statistical evaluation Students t test and the Manova test were used.

Results

A is the distance between the coracoid process and the upper edge of the clavicle. B is the perpendicular distance between the coracoid process and the upper edge of the lateral part of the clavicle. C is the perpendicular distance between the upper edge of the acromion and the upper edge of the clavicle. D is the perpendicular distance between the coracoid process and the lower edge of the clavicle. E is the shortest distance between the coracoid

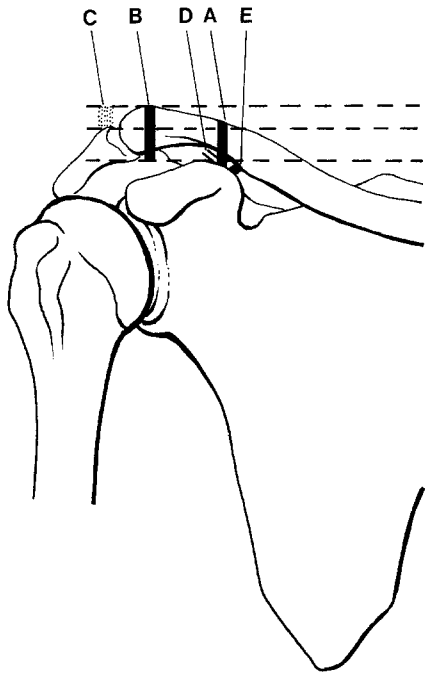

Fig. 1. Schematic drawing of the measurements used in the study (see text for further details)

Table 1. Mean, standard deviation (Std), and variance (Var) values in the study (mm)

Measurement	Mean	Std	Var
A	21.31	0.36	0.29
B	20.66	0.29	0.12
C	8.45	0.28	0.28
D	8.16	0.31	0.21
E	8.33	0.17	0.04

Table 2. The effect of stress

Measurement	Without stress	With stress
A (mm)	21.81	22.61
B (mm)	21.46	20.81
Acromioclavicular width (mm)	3.56	4.12

process and the lower edge of the clavicle. The differences of the measured values between corresponding radiographs were: A=4.5%+/−4.0% (±1 SD); B=4.5% +/−4.4%; C=9.3%+/−9.5%; D=10.8%+/−12%; E=11.6%+/−16.5%. The accuracy of the measurements A and B was significantly better than that of C, D, and E (Manova $p=0.001$). The probability that A and B diverge from one another was 0.995. The average measures are seen in Table 1.

The effect of stress on measurments A and B is shown in Table 2. Measurement A was reduced in 11 cases (34.4%) with stress, and increased in 21 cases (65.6%). The corresponding values for measurement B were 21 (65.6%) and 11 (34.4%). The correlation between the measured values was 0.587. The change caused by stress was greater in 14 shoulders from measurement A and in 18 shoulders from measurement B. With both A and B, the variation caused by stress was <3 mm (93% probability, test proportions based on standardised normal distribution).

The angle between the sternoclavicular and AC joints describing clavicular torsion varied from 3.5° to 45°. The thickness of the lateral part of the clavicle varied between 7.5 and 22.2 mm. The difference between the right and left sides was from 0 to 4.5 mm. The AC joint space without stress averaged 3.6 mm (range 2–5.4 mm) and with stress, 4.1 mm.

Discussion

Evaluation of the AC joint is inconvenient, and mistakes in projections often cause faulty interpretations. This makes more difficult an objective evaluation of the results after different techniques. The possibility of errors is increased when the radiographer is changed. Relatively large variations of the short measurements (C, D, and E) can be explained by anatomical variations. The smallest differences were among the longer measurements (A and B), which were almost equal.

In the present study, stress caused sinking of the lateral part of the clavicle and an increase in the distance between the coracoid process and the upper edge of the clavicle in normal subjects. The sinking of the lateral part of the clavicle may be caused by a change in posture. The distance from the coracoid process to the upper edge of the clavicle seemed to be the least affected by errors in projection. A difference induced by stress exceeding 3 mm seemed to be abnormal.

There was no standard distribution of the clavicular torsion. The thickness of the lateral end of the clavicle differs greatly both between shoulders and individuals. Widening of the AC joint space exceeding 6.5 mm can be considered as abnormal.

Special attention should be paid to standard projections in the radiological examination of the AC joint. Radiography should be undertaken on a wide plain film, with both AC joints together. The distance between the coracoid process and the upper edge of the clavicle should be used for the evaluation of laxity of the joint.

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