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Variation in Acromioclavicular inclination angle in coronal plane and it's implication in Tension Band wiring for fracture distal end of clavicle

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Abstract

Background: Implant failures of trans Acromion fixation in case of displaced distal end of clavicle fractures are common due to the variation in anatomy of Acromioclavicular joint. And also variations in Acromion morphology widely studied. **Objectives**: To study the coronal angulation of Acromioclavicular in X-rays and correlate with types of Acromion and to study the available lateral part of clavicle for fixation with trans Acromion pins **Methods**: We measured the angle of coronal inclination between Acromion and Lateral clavicle and grouped them according to Acromion types. Also we measured the maximum possible length of lateral clavicle available for k wire fixation. **Results**: The Types of Acromion were 24:46:30 and the mean coronal angle was 156.06 with SD of 10.084. and the lateral clavicle length available decreased on decrease in coronal angle

Keywords: Acromioclavicular inclination, Lateral Acromion Angle, fracture distal end of clavicle, tension band wiring.

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Introduction

Fracture distal end of clavicle are common injuries that need surgical intervention. Trans Acromial pinning, Tension Band wiring, Hook plate fixation and Coracoclavicular fixation are the various modes of fixation available and practiced by Surgeons all around the world. Trans Acromial pinning and tension band wiring are with same principles of fixing K wires across the Acromioclavicular clavicular joints, either retrogradely or antegradely. The morphology of Acromion and its variation in types of acromion are widely studied by various authors. Also the longitudinal axis between the acromion and lateral end of clavicle in coronal plane at its articulation varies individually and with types. This influences the level of fixation that is , the available lateral distance of clavicle for K wire hold and thereby also influences the outcome of fixations of fractures of lateral end of clavicle. Lesser the distance available, lesser stability of the fixation. Authors of this study therefore aimed to study the variations in the angles of longitudinal axis of acromion and longitudinal axis of lateral end of clavicle at their articular point and its implication in the variation in available lateral part of clavicle in terms of distance from lateral end, for fixation.

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Aim

1. To measure the angle between Longitudinal axis of acromion and lateral end of clavicle and to derive average angle for each type of Acromion
2. To measure the average available lateral part of clavicle by drawing imaginary possible trajectory

Morphological classification of acromion

Types of Acromion morphology and its relation with Rotator cuff impingement and tendinitis are well studied. Neer CS first described about the impingement during 1972.

During 1986, Biglani LU et al described Type1 flat Acromion, Type 2 Curved Acromion and Type 3 Hooked Acromion and also described Acromion Slope in outlet view of shoulder. Kitay et al during 1995 described Acromion tilt in connection with Rotator cuff impingement syndrome.Some authors like Scott.R.Jacobson et al (11) disagree the delineation between Type 2 and Type 3 Acromions. Many of the authors agree the Biglani classification including author Gregory P.Nicholson et al(12) who extensively studied the morphology of acromion and described the age related changes in types.Colgate-Stone(15) et al described the types of Acromioclavicular joint according to inclination of Acromion.

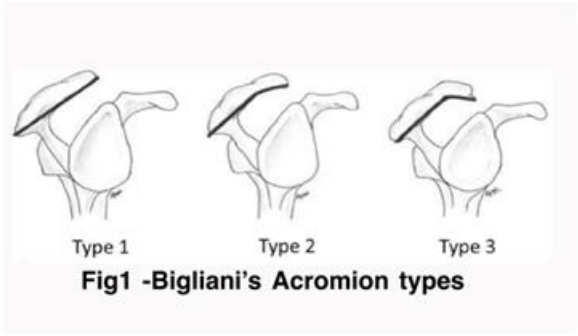

Figure 1

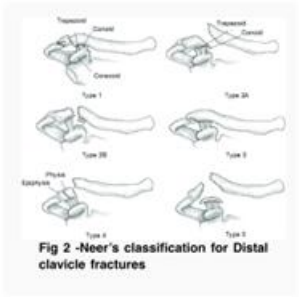

Figure 2

Materials and Methods

The normal shoulder X-rays are taken for Angle measurement. The 100 Shoulder Anteroposterior X-rays taken for injury shoulder at department of Orthopaedics at Thiruvarur Medical college from September 2022 to December 22 are taken for Examination. Also outlet views are taken for typing of the Acromion. Both side X-rays, both sex with age between 20 to 50 were used. Patients with fractures, and Acromioclavicular arthritis are excluded.Digitalised X-ray was taken with patient

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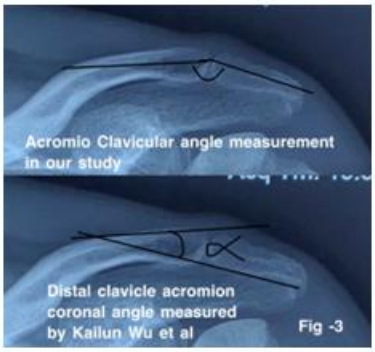

Figure 3

standing and X-ray tube directed horizontally without any cephalocaudal tilt. X-rays are saved as DICOM images and with angle meter software, the angle measurement and length measurement.Out of 100 X-rays , Right left ratio was 64:36 and Male Female ratio was 68:32.

For Acromio lateral clavicle angle measurement, central Longitudinal axis line drawn intersecting vertical 2 points(superior-most and inferior-most) of medial and lateral borders.This line was intersected with another line drawn along the longitudinal axis of lateral third of clavicle which was drawn by intersecting lines between lateral and 4 cms medial to above said points of clavicle (superior-most and inferior-most).Then the angle between these two lines are measured and recorded. These angles are grouped into three according to the types of Acromion.

For imaginary trajectory, the trajectory which occupies maximum part of lateral clavicle, was drawn and the length between the lateral end and point in which trajectory exits the superior cortex was measured and again grouped according to the types of acromion. The data were entered in SPSS software version26 and analysed.

Results

Among the 100 shoulders, Type 1 Acromion were 24 in numbers, Type 2 Acromion were 46 in numbers and Type 3 Acromion were 30 in numbers. In view of Age, 21 to 30 were 25 in numbers, 31 to 40 were 35 in numbers and 41 to 50 were 40 in numbers. In 21-30 age group Acromion types were 5:13:7, 31- 40 group Acromion types were 7:13:15 and in 41-50 age group Acromion types were 12:20:8 respectively. In male population Acromion types were 17:31:20 and in female population Acromion types were 7:15:10 respectively.

Table 2: Result of Acromio-Lateral clavicle angle range and range of available lateral clavicle in mm

	Angle between acromion and Lateral clavicle (Range in degrees)	**Available lateral clavicle for fixation (Range in mm)**
Type 1 Acromion	165 to 176 degrees	46mm to 53mm
Type 2 Acromion	151 to 164 degrees	40mm to 45mm
Type 3 Acromion	138 to 149 degrees	33mm to 39mm

Average angle between axis of Acromion and lateral clavicle has been 169 degrees and the range was between 165 to 176 in 24samples which fall in Type 1 Acromion group.

Average angle between axis of Acromion and lateral clavicle has been 157 degrees and the range was between 151 to 164 in 46 samples which fall in Type 2 Acromion group.

Average angle between axis of Acromion and lateral clavicle has been 143 degrees and the range was between 138 to 149 in 30samples which fall in Type 1 Acromion group.

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Table 1: Distribution according to type of Acromion

		Type 1 Acromion	**Type 2 Acromion**	**Type 3 Acromion**
Number		24	46	30
Age	21-30 n=25	5	13	7
	31-40 n=35	7	13	15
	41-50 n=40	12	20	8
Sex	Male n=68	17	31	20
	Female n=32	7	15	10
Angle between Axis of acromion and Lateral Clavicle in degrees		169.083±1.506 165 to 176	157.326±0.842 151 to 164	142.966±1.3 138 to 149
Available lateral clavicle length for K wire fixation in mm		49.25±0.946 46mm to 53mm	43±0.545 40mm to 45mm	35.36±0.613 33mm to 38mm

Average available lateral clavicle length for fixation by means of drawn trajectory in Type 1 Acromion group was 49.25mm and the range was 46mm to 53mm. Average available lateral clavicle length for fixation by means of drawn trajectory in Type 2 Acromion group was 43mm and the range was 40mm to 45mm. Average available lateral clavicle length for fixation by means of drawn trajectory in Type 3 Acromion group was 35mm and the range was 33mm to 38mm.

Discussion

Charles S. Neer (1)classified the distal end of clavicle fractures.Also he gave the solution of Trans Acromial pin fixation for distal clavicle fractures with Coracoclavicular ligament injury. According to Maristella F.Saccomanno(2) who elaborated Anatomy , Biomechanical evaluation of Acromioclavicular joint, says Coracoclavicular ligament attaches in the under surface of clavicle from 25mm to 40mm distance from lateral end of clavicle. In the Neer's type IIb fracture, the fracture line runs medial to this attachment. Consider this is2.5-4cms from lateral end of clavicle, that needs pins to exit the posterosuperior cortex of lateral clavicle at least 45 to 50mm from the lateral end during the trans Acromion pin fixation.Considering this fact and with evidence of implant failures in the tension band wiring fixations done for fracture lateral end of clavicle fractures, due to angulation between Acromion and lateral clavicle, authors decided to study the angles between Acromion and lateral clavicle and lateral length of clavicle available for k wire fixation in various types of Acromion.

Looking into the literature, many of the authors studied the sagittal alignment, of acromion and its relationship with the rotator cuff impingement. Only few authors have contributed to the coronal angulation of Acromion and lateral clavicle. John D. MacGillvary(7) has classified the AC joints with Lateral Acromion angle in coronal plane into neutral type (0^o to 10^o) and downward sloping type($>10^o$). Kailun Wu et al (8)who described in their article on lateral Acromion angle and postoperative pain of distal clavicle fractures treated with hook plates have used angle between inferior border of acromion and superior border of clavicle as a angle(180 - angle). When the angle goes above 40^o then the implant failure chances are more.In radiopaedia site an article revised by Jeremy Jones, says 3 types in Acromioclavicular configuration namely 1)Horizontal 2)Low lying 3) Inferolateral. 2 and 3 types are associated with impingement.

In our study, when the coronal angle between Acromion and lateral clavicle decreases, the possible trajectory decreases.When the Acromioclavicular coronal plane angle decreases less

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than 150degrees the available clavicle length past the fracture line will become insufficient for fixation.

Recommendations

For type 2 distal clavicle fractures it is necessary to take normal side shoulder X-ray and look for abnormal coronal angulation in Acromioclavicular joint.If angulation is less than 165 degrees, TransAcromial pins and tension band wiring will be difficult since the trajectory is not favourable and also the fixation will be inadequate which may lead to implant loosening, regarding fixation of lateral clavicle fractures the and other modes of fixation may be considered.

Conclusion

The authors recommend for properly do radiological evaluation of shoulders before planning for fixation of lateral clavicle fractures. Also like to stress upon the need of further extensive radiological and post mortem studies in Indian population in this regard.

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