Characteristic

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RESEARCH

Characteristics of acromial morphology in patients with painful shoulders from Indonesia

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Abstract

Background Shoulder pain is a common reason for patients to seek care from general practitioners or orthopaedic specialists. Prior studies suggest a correlation between acromial morphology and shoulder pathologies. This study aimed to determine acromion characteristics in the Indonesian population and evaluate associations between acromion type, radiographic parameters, sex, and shoulder disorders.

Methods A cross-sectional study was conducted on 487 patients with shoulder disorders, using consecutive sampling and data from our institution's radiology database (2020—2021). Acromion morphology was classified using the Bigliani system. Diagnoses were based on clinical and radiological records. Radiographic parameters assessed included critical shoulder angle (CSA), acromion index (AI), lateral acromial angle (LAA), acromioclavicular (AC) joint distance, acromiohumeral (AH) joint distance, and acromial tilt.

Results Among 487 patients, type II acromion was most common (59.5%), followed by type I (33.3%), type IV (4.5%), and type 111 (2.7%). Mean CSA was 38.36±5.13, AI 0.72±0.09, LAA 72.52±6.01, AC joint distance 3.18±0.89, AH distance 8.61 ± I .86, and acromial tilt 28.84±4.52. No significant association was found between acromion type and shoulder disorders (p =0.34), or between sex and acromion type (p =0.516). Radiographic parameters also showed no significant correlation with shoulder disorders.

Conclusion Type II acromion was the most prevalent in this Indonesian population. No significant associations were observed between acromion type, sex, or radiographic parameters and shoulder pathologies. Acromial morphology may represent normal anatomical variation rather than a pathological finding.

Keywords Acromial morphology • Shoulder pathology • Radiographic parameters • Bigliani classification • Indonesian population

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Introduction

Shoulder pain is one of the most common reasons patients seek care from general practitioners or orthopaedic specialists. Studies have shown that 44—65% of shoulder complaints are caused by shoulder impingement syndrome [1—3]. In addition to impingement, another frequent aetiology underlying shoulder pain is rotator cuff tear [4—6]. These two conditions are often interrelated. Several previous studies have suggested that the morphology of the acromion may be one of the contributing factors to the development of these shoulder disorders [7—14].

The ongoing discussion revolves around whether the various shapes of the acromion are present from birth (congenital) or develop over time (acquired), as acromion is a major associated structure of several shoulder pathologies, such as subacromial impingement syndrome, calcific tendinitis, and rotator cuff injury. In 1986, Bigliani et al. described a classification of acromial morphology that qualitatively distinguished 'flat' (Type 1), 'curved' (Type 2), and 'hooked' (Type 3) acromion shapes. A rare 'reversed curved' (Type 4) acromion was subsequently added [15]. Acromion morphology can be categorized through various classifications using radiographs or MRI. These include the acromion slope (AS) according to Bigliani et al. and Kitay et al., the acromial type (AT) according to Bigliani et al., the acromial tilt by Kitay et al., the lateral acromial angle (LAA) according to Banas et al., and the acromial index (AI) according to Nyffeler et al. Several research studies have indicated a connection between type 3 acromion and shoulder conditions like rotator cuff tears and shoulder impingement syndrome [7—14].

Conventional radiology, such as plain x-ray plays a crucial role as a diagnostic tool in the initial stage of detecting shoulder deformities. Moreover, plain X-rays can provide valuable information about acromion morphology, particularly when evaluating the shape and alignment of the acromion. More advanced radiography, such as MRI and CT scans are also useful in determining the acromion morphology, yet both have disadvantages of higher cost and patient inconvenience [7].

The primary objective of this study was to determine the acromion characteristics among the Indonesian population. The secondary objective was to establish if there is a correlation between sex, acromion type, shoulder measurements and the presence of any shoulder pathologies.

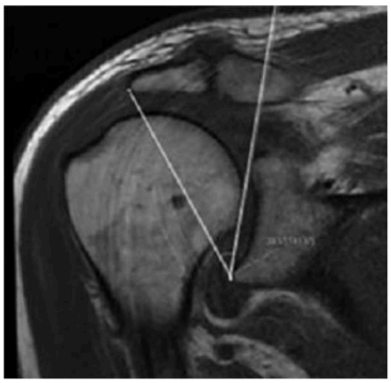

Fig. 1 Critical shoulder angle

Patients and methods

Patients

A cross-sectional study with consecutive sampling was conducted on 487 patients with shoulder disorders, using data extracted from the electronic radiology database at our institution from 2020 to 2021. The exclusion criteria were: [1] a history of upper limb fractures or ligamentous Injuries; [2] previous shoulder dislocation; and [3] a history of shoulder surgery. The acromial morphology was classified according to the Bigliani classification as type I (flat), type 2 (curved), type 3 (hooked), or type 4 (reversed curved) [15]. Shoulder disorders were identified based on clinical and radiological diagnoses documented in the patients' medical records. The following radiographic parameters were evaluated: critical shoulder angle (CSA), acromion index (AI), lateral acromial angle (LAA), acromioclavicular (AC) joint distance, acromiohumeral (AH) joint distance, and acromial tilt.

Critical shoulder angle

The critical shoulder angle (CSA) is defined as the angle formed by the intersection of two lines: one connecting the superior and inferior margins of the glenoid, and the other extending from the inferior glenoid margin to the most lateral point of the acromion [16] (Fig. 1).

Acromion index

The acrormon index is measured on anteroposterior (AP) radiographs and is calculated as the ratio between the distance from the glenoid plane to the lateral edge of the acromion and the distance from the glenoid plane to the lateral aspect of the humeral head. A greater lateral extension of the acromion corresponds to a higher acromion index [10] (Fig. 2).

Lateral acromial angle

The lateral acromial angle (LAA) quantifies the inclination of the acromion relative to the glenoid. It is formed by two lines: the first drawn between the superior and inferior lateral points of the glenoid, representing the glenoid surface; and the second drawn parallel to the undersurface of the acromion. A smaller LAA has been associated with an increased risk of rotator cuff tears due to a higher likelihood of subacromial impingement [10] (Fig. 4).

Fig. 2 Acromion index

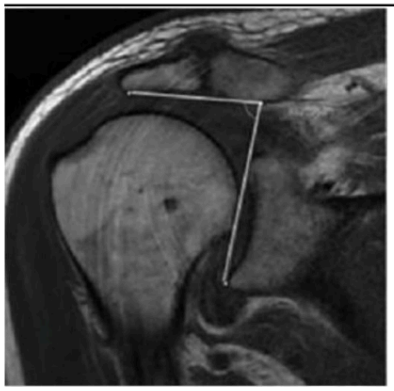

Fig. 3 Lateral acromial angle

Acromioclavicular joint distance

The acromioclavicular (AC) joint distance refers to the space within the synovial joint between the oval facet of the acromion and the facet on the distal end of the clavicle [18] (Fig. 4).

Fig. 4 Acromioclavicular joint distance

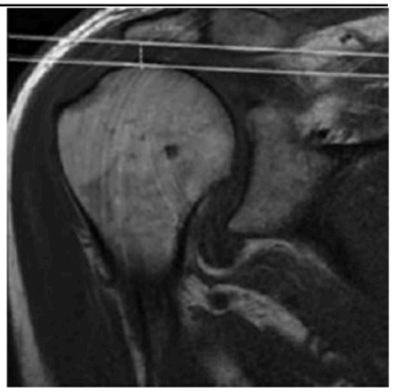

Fig. 5 Acromiohumeral distance

Acromiohumeral joint distance

The acromiohumeral (AH) distance is defined as the shortest vertical distance between the inferior cortex of the acromion and the superior aspect of the humeral head. This measurement is typically obtained from an anteroposterior radiograph of the shoulder [20] (Fig. 5).

Acromial Tilt

The acromial tilt (AT) is measured on an outlet-view radiograph. It is the angle between two lines: one connecting the most posterior and anterior points of the inferior acromion, and the second extending from the same posterior point to the inferior tip ofthe coracoid process [10] (Fig. 6).

Fig. 6 Acromial tilt [21]

Statistical analysis

We analyzed the relationship between acromion type, shoulder measurements, and other variables such as sex with the presence of shoulder disorders. Acromion type, sex, and shoulder disorders were treated as categorical variables, while shoulder measurements were treated as continuous variables. A chi-square test was used to evaluate the association between acromion type and shoulder disorders.

Normality testing was performed on the continuous shoulder measurement variables. Critical shoulder angle (CSA), acromion index (AI), acromioclavicular (AC) distance, and acromiohumeral (AH) distance were not normally distributed; therefore, Spearman's rank correlation test was used to examine their relationship with shoulder disorders. In contrast, lateral acromial angle (LAA) and acromial tilt (AT) were normally distributed, and Pearson's correlation test was applied to assess their association with shoulder disorders.

All statistical analyses were conducted using SPSS software (version 29), with a p-value of < 0.05 considered statistically significant. Results were presented as mean ± standard deviation (SD) for continuous variables and as percentages for categorical variables. P-values were reported for inferential statistical tests.

Table 1 Descriptive statistics

	Range	Mean	Std. Deviation
Age	16-88	54.7	13.6
Critical Shoulder Angle	22.5-54.1	38.3	5.1
Acromion Index	0.44—1.03	0.72	0.08
Lateral Acromial Angle	54.10-92.30	72.52	6.01
AC Joint distance mm AH Joint distance	1.1-6.6	3.2	0.8
mm	4.4_13.2	8.6	1.8
Acromial Tilt	18.10-46.10	28.84	4.51

Results

Characteristics of the patient

A total of 487 patients from the radiology database between 2021 and 2022 were included in the present study. The mean age of the patients was 54.75±13.60 years, with a higher proportion of males compared to females. The mean critical shoulder angle (CSA) was 38.36±5.13 ^{0}, the acromion index (Al) was 0.72 ± 0.09, the lateral acromial angle (LAA) was 72.52±6.01 ^{0}, the acromioclavicular (AC) joint distance was 3.18±0.89 mm, the acromiohumeral (AH) distance was 8.61 ± 1.86 mm, and the acromial tilt (AT) was 28.84±4.52^{0} (Table 1).

Acromion type

Four types of acromion were identified in the Indonesian population, with type Il being the most prevalent, observed in 59.5% of cases. This was followed by type I in 33.3%, type IV in 4.5%, and type Ill in 2.7% of cases (Table 2).

All patients were included to evaluate acromial characteristics in the Indonesian population. Correlations between sex, acromion type, shoulder measurements, and shoulder pathologies were assessed using a sample that met the eligibility criteria outlined in the Methods section. The incidence of chronic shoulder pain was highest in patients with type 3 acromion (37.5%). However, in cases of rotator cuff disorders, type 4 acromion was the most frequently observed (50.0%), followed by type 2 (40.4%) and type I (39.8%).

Table 2 Distribution of acromial morphology by sex and age group

			1	2	3	4	
Male	Age	0–9	1	0	0	0	1
		10–19	1	1	0	0	2
		20–29	2	6	1	1	10
		30–39	4	12	0	1	17
		40–49	10	16	2	2	30
		50–59	14	26	0	2	42
		60–69	22	25	0	0	47
		70–79	5	13	0	2	20
		80–89	3	2	0	0	5
		19					
		20-29	10	30-39	17		
		40—49	10		2	2	30
		50-59				2	42
		60-69	47	70_79	2	20	80-89
					5		
	Total		62	101	3	8	174
Female		Age	10-19	1	3	4	20-29
			3	5			
			9	30-39	1	12	5
			19				
		40-49	20	38	3		61
		50-59	38	71	5	2	116
		60-69	20	42		3	65
			70_79	13			13
			28				
			80-89	4	5	0	2
			11				
			Total	100	189	10	14
			313				
	Total		162	290	13	22	487

Table 3 Acromial type and disease

Classification	Acromial Type				Total
	1	2	3	4	
Shoulder Stiffness	15	25	1	1	42
Asymptomatic	1	1	0	0	2
Biceps-labral complex disorder	4	1	0	0	5
Biceps-labral complex disorder			3		
Rotator cuff disorder					
Shoulder impingement					
Calcific tendinitis					
Chronic shoulder pain	45	74		9	131
Trauma			1		
Arthritis	19		463		69
Other disorder	11	14	o	2	27
Total	4	3	3	1	11
Sex					
Acromial Type	Total	1	7	o	o	8
		7		70		115
		1				
		05		50		111
		-				
		113	183	8	18	322

distance, and AH distance) and shoulder disorders. No statistically significant correlations were found between these measurements and the presence of shoulder disorders.

o o Discussion

In our study, 59.5% of patients had a type Il acromion, while only 2.7% had a type Ill acromion. These findings are consistent with previous studies by Albar et al. and Prasetyo et al., who also investigated acromial morphology in the Indonesian population and identified type Il acromion as the most commonly observed variant [22, 23]. The highest Shoulder impingement was most commonly found in individuals with type 2 acromion (25.1%), followed by type 3 (12.5%) (Table 3).

Correlations

A chi-square statistical test was performed to assess the association between acromion type and shoulder disorders. The result yielded a p-value of 0.34, indicating no statistically significant association between acromion type and shoulder disorders. Additionally, a Pearson chi-square test was conducted to evaluate the relationship between sex and acromion type, with a p-value of 0.516, suggesting no significant correlation between the two variables. Correlation analysis was also performed to investigate the relationship between shoulder measurements (CSA, Al, LAA, AT, AC incidence of chronic shoulder pain was observed in patients with a type Ill acromion (37.5%). However, a chi-square statistical test assessing the association between acromion type and shoulder disorders yielded a p-value of 0.34, indicating no statistically significant relationship.

These findings are inconsistent with some previous studies, which have reported that type 3 acromion is associated with a higher risk of shoulder disorders—particularly outlet impingement—compared to other acromion types. This has been attributed to the hypothesis that a type 3 acromion reduces the subacromial space, thereby increasing the likelihood of friction between the acromion and the rotator cuff tendons [7—14].

On the other hand, our findings are consistent with a study by Prasetyo et al., which investigated the relationship between shoulder impingement syndrome (SIS) and acromial morphological characteristics—including the acromial tilt angle and subacromial osteophytes—in an Indonesian population. Their study found no significant association between acromion type and SIS, nor between the acromial tilt angle and SIS. Additionally, they reported that subacromial osteophytes were significantly correlated with the incidence of SIS [22]. In our study, however, no patients were found to have subacromial osteophytes.

Our results also align with those of Albar et al., who examined the relationship between shoulder pain assessed using the American Shoulder and Elbow Surgeons score and acromion morphology in an Indonesian population. Their study likewise reported no significant correlation between acromion type and shoulder pain. Furthermore, they explored the association between acromiohumeral distance on MRI and shoulder pain, and identified a moderate correlation [23]. In contrast, our study analyzed the relationship between CSA, Al, LAA, AT, AC distance, and AH distance with shoulder disorders, and found no significant correlations among these variables. Furthermore, no significant correlation was found between acromion type and either age or sex, which is consistent with the findings of previous studies [10, 24, 25].

Our study has several limitations. First, we only obtained samples from patients who had shoulder disorders and could not compare them with swith those without shoulder disorders. Second, the number of patients with acromion type 3 was much smaller compared to types 1 and 2, which could introduce bias in identifying the relationship between acromion type and shoulder disorders. Third, there was a gender imbalance with more female patients than male patients. Finally, because this is a cross-sectional study, we cannot conclude a causal relationship between acromion type, shoulder morphology and shoulder disorders. Our patients come from various regions in Indonesia so that the existing sample represents the population in Indonesia, but cannot be generalized to other Asian countries.

Conclusion

Among the 487 patients included in this study, only 13 (2.7%) had a type 3 acromion. Type 2 was the most common, observed in 290 patients (59.5%), followed by type I in 162 patients (33.3%) and type 4 in 22 patients (4.5%).

The mean critical shoulder angle was 38.36±5.13, the acromion index was 0.72±0.09, the lateral acromial angle was 72.52±6.01, the AC joint distance was 3.18±0.89, the AH joint distance was 8.61 ± 1.86, and the acromial tilt was 28.84±4.52. No significant associations were found between sex, acromion type, or shoulder measurements and the incidence of shoulder disorders. This study may serve as an educational resource for patients, emphasizing that acromion type—including type 3—is a normal anatomical variation and is not associated with an increased incidence of shoulder pathologies. Future studies are encouraged to include a larger sample size with a more balanced distribution of acromion types to mlmmize potential bias.

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Author contributions XA: Conceptualization, Data curation, Investigation, Methodology, Writing — original draft, Writing — review & editing. LS: Conceptualization, Data curation, Methodology, Writing — original draft. MA: Conceptualization, Data curation, Methodology, Writing — original draft. EK: Supervision, Methodology, Writing — review & editing.

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Data availability NO datasets were generated or analysed during the current study.

Ethical approval was waived by the local ethics committee in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

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Competing interests The authors declare no competing interests.

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