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Evaluation of acromion morphology and subacromial distance in patients with shoulder pain

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Ethics Committee Approval
The approval for the study was obtained from the Non-Invasive Clinical Research Ethics Committee of Çukurova University (approval number: 91/12, date: 04.09.2019).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Acromion morphology is not always considered when examining pathologies that may cause shoulder pain in patients who are undergoing physical therapy. However, acromion morphology and the changes caused by these morphological variations in the subacromial distance may cause serious shoulder problems during physical therapy. In this study, the effects of acromion morphology and subacromial distance measurements on shoulder pain were investigated, and the effects of various factors on acromion types were examined.

Methods: Our study was a cross-sectional design, and in total, 240 patients had shoulder magnetic resonance images (MRIs) were included in the study. The study included patients with shoulder pain persisting for at least eight weeks and excluded patients with a history of fractures, peripheral nerve damage, osteogenesis imperfecta, and severe osteoporosis. Acromial morphology and subacromial distance were examined on MRIs. Acromial morphology was examined in four subgroups according to the classification by Vanarthos and Monu (1995). Furthermore, the patients were divided into three age groups (18–30, 31–45, and 46–60), and acromion types were examined based on these age groups. In addition, patients' demographic data were collected, and patients were questioned about painful extremities, dominant extremity, and pain status based on the visual analogue scale (VAS).

Results: Subacromial space was measured by determining acromion types using MRIs, and mean subacromial distance was 7.91 mm. Acromion types had significant differences in terms of subacromial distance values ($P < 0.001$). Pairwise comparisons revealed that the subacromial distance values of Type 3 patients were lower than that of Types 1, 2, and 4 patients ($P < 0.001$, $P = 0.001$, and $P < 0.001$, respectively).

Conclusion: The study results revealed that injury of the rotator cuff muscles may occur more frequently in Type 3 acromion than in other acromion types because of the low subacromial distance value. Acromion types, especially the subacromial distance, must be considered in patients with shoulder pain.

Keywords: Acromion shape, Shoulder pain, Rotator cuff pathologies, Subacromial distance, Acromion types

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Introduction

The shoulder joint has a wide range of motion and poor joint contact. It is the most complex joint of the body with support for this joint contact provided by cartilage and ligaments that secure the range of motion. Injuries of the shoulder joint, a structure that acts as a link between the upper extremity and the trunk, severely affects the quality of life in individuals [1].

The rotator cuff muscles act as a compressor of the humeral head against the glenoid cavity and provide shoulder movements on different spatial planes. Rotator cuff pathologies lead to disruption of this balance and may cause more advanced injuries with the elevation of the humeral head. This assessment, called subacromial space, is determined by measuring the distance from the humerus to the acromion [2–7]. Clinically, this measurement can be used to evaluate the function of the rotator cuff and to help select the type of therapy to be used. An acromiohumeral distance ≤ 7 mm measured on an anteroposterior radiograph suggests the presence of a large rotator cuff tear and reduced likelihood of successful outcome after surgical treatment [3, 8–10].

Shoulder pain is the most common musculoskeletal problem after low back and neck pain [11–13]. A literature review has shown that the causes of shoulder pain are classified in 91% of the articles. In this classification, 52% is classified as subacromial pain, 17% instability, 9% adhesive capsulitis, and 4% other diagnoses [12]. Another study found that rotator cuff lesions accounted for 65% of shoulder pain cases, whereas the pathology of art. acromioclavicularis accounted for 10% of the cases [14]. Studies have found many risk factors, such as sex, obesity, advanced age, trauma, and anatomical, neurological, and psychological problems. Furthermore, shoulder pain is reportedly more common in employed people than in unemployed people. In addition, sports that require repetitive motion and sports that require throwing have been found to carry a higher risk for shoulder pain than other sports [15–18].

Acromion morphology is not always considered when examining pathologies that may cause shoulder pain in patients who are undergoing physical therapy. However, acromion morphology and the changes caused by these morphological variations in the subacromial space may cause serious shoulder problems during physical therapy. The effect of acromion morphology and subacromial space measurements on shoulder pain were investigated and the effects of various factors on acromion types were examined.

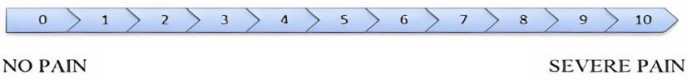
Materials and methods

Our study is a cross-sectional study, and in total, 240 patients (120 males and 120 females; age, 18–60 years) who presented to Adana Private Yaşam Medical Center Physical Therapy Unit in 2019 and to the Health Sciences University Gaziosmanpaşa Training and Research Hospital in 2020 and had shoulder magnetic resonance images (MRIs) were included in the study. The study included patients with shoulder pain persisting for at least eight weeks and excluded patients with a history of fracture, peripheral nerve damage, osteogenesis imperfecta, and severe osteoporosis. Approval for the study was obtained from the Non-Invasive Clinical Research Ethics Committee of Çukurova University (approval number: 91/12, date: 04.09.2019) and permission from the participating the healthcare institutions was granted before performing measurements on the existing MRIs of the patients. The patients who were diagnosed based on MRIs were asked to sign an informed consent form when they started physical therapy. Furthermore, the patients were divided into three age groups (18–30, 31–45, and 46–60), and acromion types were examined by these age groups. In addition, patients' demographic data (body weight, height, and body mass index [BMI]) were collected, and patients were questioned about painful extremities, dominant extremity, and pain status based on the visual analogue scale (VAS). Examinations of the MRIs were performed on the data obtained from the 1.5 Tesla GE SIGNA EXPLORER device.

VAS

To determine the severity of the pain status of patients with shoulder pain, the VAS, a measurement tool, was used to measure values that could not be measured directly (Figure 1). Usually, a 10-cm line is drawn and extreme limit definitions are written on both ends of the parameter to be evaluated, and the patient is then asked to indicate the location on this line that applies to their condition by drawing a line, placing a dot, or pointing.

Figure 1: Visual Analogue Scale



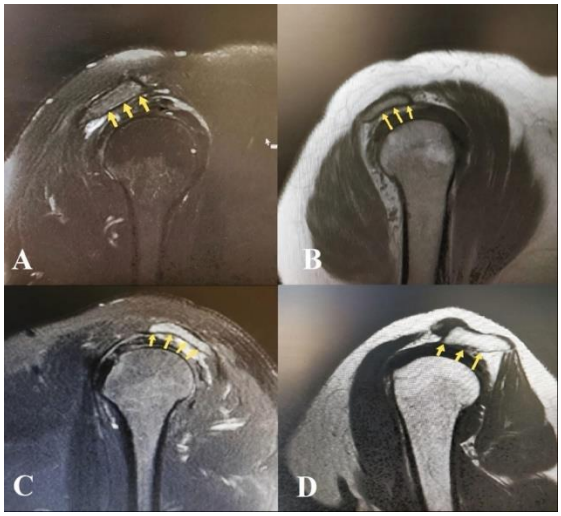
The numbers used in Figure 1 are indicated in cm.

MRI image measurements

Acromial morphology was classified into three different types by Bigliani (1986) [19]. In addition, Vanarthos and Monu (1995) defined Type 4 acromion with a convex undersurface [20]. In our study, acromial morphology was examined in four subgroups according to the classification by Vanarthos and Monu (1995) as shown in Figure 2:

a) Type 1 acromion: It has a flat undersurface.
b) Type 2 acromion: It has a smooth, curved lower surface that is almost parallel to the superior caput humeri on the sagittal oblique plane.
c) Type 3 acromion: It has a hook shape in the anterior portion and is greatly predisposed to rotator cuff tears.
d) Type 4 acromion: It has a convex undersurface.

Figure 2: Type 1 acromion (A), Type 2 acromion (B), Type 3 acromion (C), and Type 4 acromion (D) on sagittal oblique T1 SE images



Subacromial distance was measured from the caput humeri to the distal end of the acromion (Figure 3).

Figure 3: Subacromial Distance Measurement

The evaluation of MRIs was performed under supervision of a specialist radiologist, and the measurements were repeated twice by a single author. Intraclass correlation coefficients ([ICC] with 95% confidence intervals [CI]) were used for reliability testing. When the intra-observer reliability was examined in all measurements, the ICC value was found between 0.93 and 0.96. All MRIs were measured by using axial proton density fast spin echo (PD FSE), coronal oblique T1 SE, coronal oblique PD FSE, and sagittal oblique T1 SE sequences. Acromion types were established on sagittal oblique T1 SE images. Subacromial distance measurements were made on sagittal oblique T1 SE images. Measurements were recorded in "mm". MR measurements were performed electronically on the computer using ExtremePacs Pacs Software 4.3 (Çankaya, Ankara).

Statistical analysis

Sample size was determined using G*Power (v3.1.9) software based on the subacromial distance values in a previously published study by Duymuş et al. [21]. Effect size was calculated as d = 0.508, assuming a power of 80% and alpha of 0.05, and the minimum required sample size was 62 patients per gender.

R version 2.15.3 program (R Core Team, 2013) was used for statistical analysis. Study data were reported by using mean, standard deviation, median, first quartile, third quartile, frequency, and percentage. The conformity of the quantitative data to the normal distribution was evaluated with the Shapiro–Wilk test and graphic reviews. Independent sample t-tests were used for evaluating normally distributed variables between two groups. The Kruskal–Wallis test was used in the intergroup evaluations of non-normally distributed variables, and the Dunn–Bonferroni test was used to identify the source of significance in cases in which significance was found. Pearson's chi-square, Fisher's exact, and Fisher–Freeman–Halton exact tests were used for comparisons between qualitative variables. Pearson's correlation coefficient was used to determine the level of relationship between quantitative variables. Statistical significance was set at $P < 0.05$.

Results

Demographic data of the patients included in the study are given in Table 1. The patients' ages ranged from 19 to 60 years with an average of 44.39 (10.01) years. No statistically significant difference in patient ages according to sex ($P > 0.05$) was found. While the male's height, weight, BMI, and subacromial distance values were higher than the female's, their VAS scores were lower ($P < 0.001$, $P < 0.001$, $P < 0.001$, $P < 0.001$, and $P = 0.015$, respectively).

Table 1: Minimum, maximum and mean (standard deviation) values of the patients' demographic data

Parameters	FEMALE		MALE		TOTAL		[a] *P*-value
	Min–Max	Mean (SD)	Min-Max	Mean (SD)	Min-Max	Mean (SD)	
Age (years)	22–60	45.25 (9.04)	19–60	43.53 (10.86)	19–60	44.39 (10.01)	0.185
Height (cm)	157–175	163.82 (3.10)	163–190	178.67 (3.60)	157–190	171.24 (8.16)	<0.001
Weight (kg)	54–81	67.62 (6.30)	68–105	86.15 (7.11)	54–105	76.9 (11.46)	<0.001
BMI (kg/m^2)	19.61–31.64	25.23 (2.59)	21.46–32.87	27.01 (2.07)	19.61–32.87	26.12 (2.51)	<0.001
VAS	5–7	5.60 (0.64)	4–8	5.40 (0.63)	4–8	5.5 (0.64)	0.015
Subacromial distance (mm)	4.40–11.70	7.50 (1.29)	5.50–11.27	8.32 (1.22)	4.4–11.7	7.92 (1.32)	<0.001

[a] Independent samples t-test, BMI: Body mass index, VAS: Visual analogue scale

The number of patients, VAS scores, and subacromial distance based on acromion types are shown in Table 2. A statistically significant difference was found in acromion types ($P < 0.001$). A statistically significant difference was found in subacromial distance values according to acromion types ($P < 0.001$). The pairwise comparisons performed using the Dunn–Bonferroni test showed that subacromial distance values were lower in Type 3 patients than in Types 1, 2, and 4 patients ($P < 0.001$, $P = 0.001$, and $P < 0.001$, respectively). Type 2 patients were also found to have lower values than Type 1 patients ($P < 0.001$). No statistically significant difference between other acromion types ($P > 0.05$) was found. In addition, statistical evaluations could not demonstrate any significant difference in VAS scores in terms of acromion types ($P > 0.05$).

Table 2: Number of patients, VAS scores, and subacromial distance by acromion types

	Acromion Type				*P*-value
	Type 1 Median (Q1; Q3)	Type 2 Median (Q1; Q3)	Type 3 Median (Q1; Q3)	Type 4 Median (Q1; Q3)	
n (%)	71 (29.6)	154 (64.2)	11 (4.6)	4 (1.7)	[a] <0.001*
VAS	5 (5; 6)	5 (5; 6)	6 (5; 6)	5 (5; 5.5)	[b] 0.317
Subacromial distance (mm)	8.6 (7.9; 9.9)	7.5 (6.8; 8.2)	5.8 (5.1; 6.9)	9.35 (8.35; 10.55)	[b] <0.001*

[a] One-sample chi-square test, [b] Kruskal-Wallis test, *$P < 0.05$, VAS: Visual analogue scale. The results are presented as median (first quartile; third quartile).

Acromion type comparison by age, BMI, painful extremity, and sex are shown in Table 3. No statistically significant difference was found in the analysis of the acromion types of the patients by BMI groups ($P > 0.05$). The patients were divided into three age groups, and acromion types were examined based on this classification. No statistically significant difference was found in the distribution of acromion types within age groups ($P > 0.05$). When the acromion types were examined according to the painful extremity side, no statistically significant difference was found ($P > 0.05$). When the acromion types of the patients were examined regardless of sex, a statistically significant difference was found ($p < 0.05$). However, no statistically significant difference was found in the distribution of acromion types by sex ($P > 0.05$).

Many studies have concluded that the critical value for the subacromial distance is 7 mm, and subacromial impingement syndrome is more common in patients with a distance of < 7 mm, and these patients had a considerable degree of shoulder pain. In our study, subacromial distance was divided into two

groups: (1) ≤ 7 mm and (2) > 7 mm. The comparison of age, BMI, and VAS values by subacromial distance groups is shown in Table 4. No statistically significant difference was found in the comparison of age, BMI and VAS scores between subacromial distance groups ($P > 0.05$).

Table 3: Acromion type comparison by age, BMI, painful extremity, and sex

	Acromion type				*P*-value
	Type 1 (n=71) n (%)	Type 2 (n=154) n (%)	Type 3 (n=11) n (%)	Type 4 (n=4) n (%)	
Age					[a] 0.222
18–30	11 (37.9)	14 (48.3)	2 (6.9)	2 (6.9)	
31–45	26 (27.4)	65 (68.4)	3 (3.2)	1 (1.1)	
46–60	34 (29.3)	75 (64.7)	6 (5.2)	1 (0.9)	
BMI (kg/m^2)					[a] 0.266
< 20	1 (100)	0 (0)	0 (0)	0 (0)	
20–24.9	26 (36.1)	39 (54.2)	6 (8.3)	1 (1.4)	
25–29.9	41 (26.3)	107 (68.6)	5 (3.2)	3 (1.9)	
30–34.9	3 (27.3)	8 (72.7)	0 (0)	0 (0)	
Painful extremity					[a] 0.448
Right	43 (32.6)	79 (59.8)	7 (5.3)	3 (2.3)	
Left	28 (25.9)	75 (69.4)	4 (3.7)	1 (0.9)	
Sex					[a] 0.388
Female	32 (26.7)	78 (65)	8 (6.7)	2 (1.7)	
Male	39 (32.5)	76 (63.3)	3 (2.5)	2 (1.7)	

[a] Fisher-Freeman-Halton exact test, * $P < 0.05$

Table 4: Comparison of age, BMI, and VAS values by subacromial distance groups

Parameters	Subacromial distance		[a] *P*-value
	≤ 7 mm (n=63) Mean (SD)	> 7 mm (n=177) Mean (SD)	
Age (years)	45.24 (9.51)	44.09 (10.20)	0.436
BMI (kg/m^2)	25.62 (2.53)	26.29 (2.49)	0.068
VAS	5.54 (0.67)	5.49 (0.63)	0.568

[a] Independent groups t-test, *$P < 0.05$, BMI: Body mass index, VAS: Visual analogue scale

The evaluation of sex, acromion type, and painful extremity by subacromial distance groups is shown in Table 5. Furthermore, examination of the distribution of males and females in the subacromial distance groups revealed that the percentage of men was higher in the group of patients with a subacromial distance of > 7 mm than in the group of patients with a subacromial distance ≤ 7 mm ($P < 0.001$). A statistically significant difference was found in the percentage of acromion types between patients with a subacromial distance value of > 7 mm and that of ≤ 7 mm ($P < 0.001$). Although the percentage of Type 1 acromion was higher in patients with a subacromial distance > 7 mm, the percentages of Types 2 and 3 were lower ($P < 0.001$, $P = 0.012$, and $P < 0.001$, respectively). No statistically significant differences in the percentages of painful extremity side between the subacromial distance groups were found ($P > 0.05$).

Table 5: Evaluation of gender, acromion type, and painful extremity by subacromial distance groups

	Subacromial distance		*P*-value
	≤ 7 mm (n = 63) n (%)	> 7 mm (n = 177) n (%)	
Sex			[b] < 0.001*
Female	45 (71.4)	75 (42.4)	
Male	18 (28.6)	102 (57.6)	
Acromion type			[a] < 0.001*
Type 1	2 (3.2)	69 (39)	
Type 2	50 (79.4)	104 (58.8)	
Type 3	11 (17.5)	0 (0)	
Type 4	0 (0)	4 (2.3)	
Painful extremity			[b] 0.323
Right	38 (60.3)	94 (53.1)	
Left	25 (39.7)	83 (46.9)	

[a] Fisher-Freeman-Halton exact test, [b] Pearson'S chi-square test, * $P < 0.05$, BMI: Body mass index, VAS: Visual analogue scale

A correlation analysis was performed between the subacromial distance and patients' ages, heights, weights, BMIs, and VAS scores (Table 6). A statistically significant positive correlation was found between subacromial distance and height (r = 0.282; $P < 0.001$), weight (r = 0.276; $P < 0.001$), and BMI (r = 0.147; $P = 0.023$). However, no statistically significant correlation was found between subacromial distance, patient age, and VAS scores ($P > 0.05$).

Table 6: Analysis of correlation between subacromial distance and age, height, weight, BMI, VAS, and frequency of exercise

Parameters	Subacromial distance	
	r	*P*-value
Age	−0.026	0.686
Height	0.282	< 0.001 *
Weight	0.276	< 0.001 *
BMI	0.147	0.023 *
VAS	0.030	0.638

Pearson correlation analysis, * $P < 0.05$, BMI: Body mass index, VAS: Visual analogue scale

Discussion

Most patients presenting with shoulder pain are diagnosed with subacromial impingement syndrome. It may be difficult to diagnose the cause of shoulder pain in these patients. Therefore, diagnosis can be established more easily and accurately using radiological methods. In many studies, except for those on cadavers, shoulder MRI or X-ray images are used [22–24].

In their study with 70 cadavers, Bigliani et al. [19] divided the acromion in three morphological classes according to undersurfaces. They found 17% Type 1, 43% Type 2, and 40% Type 3 acromion. In addition, they detected full-thickness rotator cuff tears in 33% of the subjects' studies and reported that Type 3 acromion is dangerous and associated with rotator cuff rupture. Subsequently, Vanarthos and Monu [20] defined Type 4 acromion as having a convex undersurface in 1995. In a study of 102 cases, Ekin et al. [25] reported the incidence of Type 1 acromion at 18%, Type 2 acromion at 61%, Type 3 acromion at 13%, and Type 4 acromion at 8%. In addition, this study reported that acromial bone spurs and sclerotic changes appeared to be significantly more common in Type 3 acromion. In another study, Coşkun et al. [26] reported the rates of acromion types as 10%, 73%, and 17% for Types 1, 2, and 3, respectively. They also reported that Type 4 acromion was not detected in either the bones or during radiological examinations. Vanarthos and Monu [20] found the percentage of Type 4 acromion as 13% in their study of 30 shoulders. Yazici et al. [27] found in their study of 80 shoulders that the percentage of Type 1 acromion was 22.5%, Type 2 acromion 70%, Type 3 acromion 5%, and Type 4 acromion 2.5%. In a study of 423 scapulae, Natsis et al. [28] found that percentage of Type 1 acromion was 12.1% (51 scapulae), Type 2 was 56.5% (239 scapulae), Type 3 was 28.8% (122 scapulae), and Type 4 was 2.6% (11 scapulae), whereas Gagey et al. [29] found 27.5% Type 1 acromion, 58.8% Type 2 acromion, 12.1% Type 3 acromion, and 1.6% Type 4 acromion. Our study examined patients with shoulder pain. Type 1 acromion was found to be 29.6%, Type 2 acromion 64.2%, Type 3 acromion 4.6% and Type 4 acromion 1.7%. The presence of significant differences between the acromion types was noted.

Although many studies have been carried out on the effect of age and acromion morphology, this issue has not been fully elucidated [23, 27, 30]. However, Edelson and Taitz [30] reported that they detected 22% Type 1, 62% Type 2, and 16% Type 3 acromions and underlined that the incidence of Type 3 acromion increased after the age of 30 years. In their study, Botanlioğlu et al. [23] could not detect a difference in acromion types based on age. They found that no transition from Type 1 acromion to Type 3 acromion or from Type 3 acromion to Type

1 acromion occurred and did not correspond to increasing age. They also reported a weak relationship between age and acromion type. In a study conducted on 154 scapulae in 2007, Type 2 acromion was found to be significantly more common in both sexes. In addition, the rates of acromion types did not differ significantly by sex or age groups [31]. Nicholson et al. [32] studied 420 scapulae and found 32% Type 1, 42% Type 2, and 26% Type 3 acromion. According to the results of this study, they emphasized that the acromion morphology did not change with age. In another study, Edelson [33] examined 750 scapulae and 80 cadavers and reported that they did not find Type 3 acromion in individuals under the age of 30 years. Some of the patients > 40 years had a protrusion at the tip of the acromion, but this protrusion was a newly formed bone at the site of attachment of the coracoacromiale ligament to the acromion. Edelson argued that Type 3 acromion is an acquired feature and occurs as a result of degenerative changes. In their study using MRI and computed tomography (CT) scans of 132 symptomatic shoulders, Macgillivray et al. [34] found that the acromion developed a downward angulation morphology with increasing age in most patients. However, Büyükbebeci et al. [35] found that Type 2 acromion was the most common type, and also Type 1 acromion is more common in people in their 30s, Type 2 acromion in 40s, and Type 3 acromion in 50s and older with an increase in acromion curve corresponding to increasing age. In their study analyzing 272 cases, Wang and Shapiro [36] stated that they observed a statistically significant increase in the incidence of Type 3 acromion and a statistically significant decrease in the incidence of Type 1 acromion in patients aged ≥ 50 years. In our study, no significant difference was found between acromion types and age groups.

Many studies have been conducted on the relationship between acromion morphology and rotator cuff tear. Nyffeler and Meyer [37] examined the acromion morphology of patients with degenerative rotator cuff tears and those without rotator cuff tears and reported significant intergroup differences. They stated that patients with rotator cuff tears had severe shoulder pain, so acromion morphology was an important parameter for understanding the pathomechanism of the rotator cuff. Additionally, in another study, Balke et al. [22] evaluated 126 patients who underwent arthroscopic rotator cuff repair in two groups as degenerative with supraspinatus tendon rupture and traumatic with supraspinatus tendon rupture. They stated that Type 2 acromion was equally distributed in both groups, whereas Type 1 acromion was more common in traumatic cases and Type 3 acromion morphology was more common in degenerative cases.

Narrowing of the subacromial space was first described by Golding [16] in 1962 using direct radiography of patients with rotator cuff tears. He stated that subacromial distance in healthy individuals is in the range of 7–13 mm. In a study conducted in 1968, Cotton and Rideout [15] measured the subacromial distance in patients with and without full-thickness rotator cuff tears. They stated that subacromial distance was 1–4 mm in patients with full-thickness tears and 6–14 mm in patients without tears. In another study, Yao et al. [18] reviewed the shoulder MRIs of 58 patients. From these images, they measured the distance between the upper edge of the cavitas glenoidalis and the lower point of the acromion closest to the acromioclavicularis from the coronal oblique plane and found that narrowing of this distance was associated with subacromial impingement. In a study, Saupe et al. [6] examined the anteroposterior radiography and MRI results of the patients and found the mean subacromial distance to be 5.9 mm (range, 1.2−9.8 mm). In addition, in that study, they reported that 7 mm was the critical threshold for the subacromial distance, and rotator cuff tears increased statistically significantly when subacromial distance was less than 7 mm. França et al. [3] evaluated the sagittal plane MRIs of the shoulders of 160 patients who were older than 45 years and reported that mean subacromial distance was 6.99 and 7.71 mm in the group with degeneration of the rotator cuff muscles and the control group, respectively, and subacromial distance decreased significantly according to the comparison of the two groups. Jost et al. [8] and Norwood et al. [9] reported that in clinical settings, subacromial distance measurement would help to evaluate the function of the rotator cuff muscles and to choose the treatment to be applied. Petersson and Redlund-Johnell [10] and Jost et al. [8] stated that an acromiohumeral distance of ≤ 7 mm measured on anteroposterior radiographs triggered significant damage to the rotator cuff muscles and reduced the likelihood of successful surgery. Park et al. [38] found a significant difference between VAS and subacromial distance values in the study they conducted in the general population aged 29–74 whose pain persisted for > 3 months. In our study, similar to the literature, 7 mm was set as the critical value for the subacromial distance and identified the changes above and below this threshold. No statistically significant difference was found when comparing patient age, BMI, and VAS scores between subacromial distance groups. A statistically significant difference was found in the percentages of acromion types in patients with a subacromial distance > 7 mm. Low subacromial distance values in Type 3 acromion has led us to think that the injury of the rotator cuff muscles in this group may occur more frequently than in other acromion types.

Limitations

The most important limitation of our study was the retrospective nature, and the number of patients was low due to the strict inclusion criteria.

Conclusion

Shoulder pain severely limits activities of daily living in patients who have shoulder impingement syndrome. For this reason, the treatment processes of these patients are extremely important. The morphological characteristics of the acromion and the changes that are caused by these morphology in the sub-acromial distance lay the ground for the formation of rotator cuff tears. Similar to data reported in the literature, a significant decrease was detected in the subacromial distance, especially in Type 3 acromion with hook appearance. Although a significant relationship was detected between the sub-acromial distance and VAS in the studies reported in the literature, the change in the sub-acromial distance may not be the factor that causes the pain in patients with shoulder pain as discussed in the present study. Aside from the acromion morphology, other factors that may cause changes in the subacromial distance must be examined, and the actual source of the pain should be investigated. In

addition, in line with the data obtained from our study and comparison of these data with similar studies in the literature, acromion types, especially subacromial distance, should be considered in patients with shoulder pain.

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