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Seven-year course of asymptomatic acromioclavicular osteoarthritis diagnosed by MRI

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Background: Asymptomatic acromioclavicular osteoarthritis (AC-OA) is a frequent finding in shoulder magnetic resonance imaging (MRI). Its natural course is unknown. Therefore, the question arises whether a resection should be performed simultaneously with shoulder surgery for another reason to prevent future pain and reoperation. The purpose of this study was to investigate the mid-term course of asymptomatic AC-OA.

Methods: Overall, 114 asymptomatic AC-OA diagnosed on MRI were followed for 7 years between 2011 and 2018. At baseline, MRI signal enhancement in the clavicle and acromion, OA grade, physical demand as well as the parameters (1) Constant Score Visual Analogue Scale, (2) pain on AC-joint compression, and (3) cross-body adduction test were measured. All patients were followed up after 7 years by interview, and in case of symptoms by clinical examination. The endpoint ''deterioration'' was reached if 2 of the 3 parameters turned worse.

Results: Asymptomatic AC-OA remained asymptomatic in 83% of cases, 7% turned better, 10% turned worse. Physical demand and osteoarthritis grade increased the risk of deterioration, whereas MRI signal enhancement in the clavicle or acromion had no influence on outcome. During follow-up, the frequency of pain on AC-joint compression increased from 11% to 16% ($P = .24$), the frequency of a positive cross-body adduction test increased from 6% to 20% ($P = .017$), and the mean Constant Score Visual Analogue Scale increased from 10 to 13 points ($P < .001$) indicating less pain.

Conclusions: Asymptomatic AC-OA remained asymptomatic in 90% over 7 years. A simultaneous resection of an asymptomatic AC-OA during shoulder surgery for another reason is not indicated in every patient.

Level of evidence: Level II; Retrospective Design; Prognosis Study

Keywords: Shoulder pain; acromioclavicular osteoarthritis; MRI; T_2 signal increase; natural course; shoulder surgery

This study was approved by the ethical review board (EK 24/07) of the Kantonale Ethikkomission Graubünden, and all patients have given written informed consent to participate.

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On evaluation of pain or dysfunction of the shoulder with or without trauma, diagnostic magnetic resonance imaging (MRI) is often performed to identify pathologies. Not infrequently increased T_2 signal intensity in the distal clavicular region may incidentally be detected, suggestive of the presence of acromioclavicular osteoarthritis (AC-OA), but the patient does not report prior symptoms typical of AC-OA. Fiorella et al[3] discuss the correlation between increased T_2 signal intensity in the distal clavicular region and clinical findings in 8 patients. The authors report such a T_2 signal increase in the distant clavicular region to be relatively frequent but mostly without clinical relevance. In patients with chronic shoulder pain but without further radiological signs, the T_2 signal increase may indicate the presence of early-stage AC-OA. They suggest that such patients might benefit from a resection of the acromioclavicular joint (ACJ). Shubin Stein et al[19] reported bone marrow edema in 80% of symptomatic patients but in 0% of asymptomatic patients and concluded that bone marrow edema is a unique finding of symptomatic AC-OA.

When MRI findings, apart from the AC-OA signs, and the clinical situation mandate surgical intervention, the surgeon may be tempted to also resect the ACJ during the same session, hoping to prevent a later extra intervention for AC-OA. In the literature, this issue is controversially discussed in case of concomitant rotator cuff repair.[7,13,14,16] Currently, there is no published evidence that surgical treatment of asymptomatic AC-OA is beneficial in the mid-term or long term. If the AC-OA continued to be asymptomatic without intervention, a preventive resection in the same operation would only add the risk of related adverse effects such as a destabilization of the shoulder and consequent pain.[14,18] If the AC-OA were to become symptomatic after surgery without concomitant ACJ resection, then a second surgical intervention with inherent risks would be needed that could otherwise have been prevented.

In the literature, the prevalence of asymptomatic AC-OA is described, but there are no data about its natural course:[15,17,20,21] Under the age of 30, 68% already show degenerative changes in the ACJ, over 30 years 93%, and over 50 years almost 100%.[20,21] Radiological features of AC-OA increase significantly with age.[15,17,20,21] However, clinical symptoms do not correlate with the radiological findings.[6,15,17,21]

As the mid-term course of asymptomatic AC-OA is not known, we have performed a prospective cohort study to investigate the natural course of initially asymptomatic AC-OA. Our hypothesis was that asymptomatic AC-OA diagnosed by MRI will become symptomatic in the mid-term.

Materials and methods

Study type and inclusion/exclusion criteria

The study was conducted in accordance with the declaration of Helsinki. The study is a prospective cohort study (Fig. 1). Between January 2011 and December 2012, diagnostic MRI of the shoulder was performed in 460 patients in the department of shoulder and elbow surgery of the author's hospital. An asymptomatic AC-OA was found in 156 patients (Fig. 1). Inclusion criteria for the study were: (1) Shubin Stein et al[19] AC-OA grade II or higher (grade 1 = healthy, 2 = capsular distension, 3 = slight narrowing of the joint space, small osteophytes, 4 = obvious narrowing of the joint space with irregularities, larger osteophytes) and/or (2) a T_2 signal increase in the distal clavicular or acromial region, (3) a clinical examination of the shoulder by an orthopedic surgeon. Exclusion criteria were: (1) the presence of a known trauma to the ACJ with conservative or surgical treatment, (2) the presence of a known clavicular trauma with conservative or surgical treatment in the same shoulder, (3) an ACJ resection in the same shoulder, and (4) lost to follow-up or refusal to participate. After application of the in- and exclusion criteria, 114 patients were included (average age, 47.62 ± 17.35 years; male/female 26%/74%, Table I).

All included patients were contacted in 2018 (6-7 years after diagnosis) by mail containing a questionnaire with an image of the shoulder, and were also contacted for a telephone interview. Patients were asked if they could sleep on the shoulder and adduct the shoulder (=equivalent to the cross-body adduction test), if

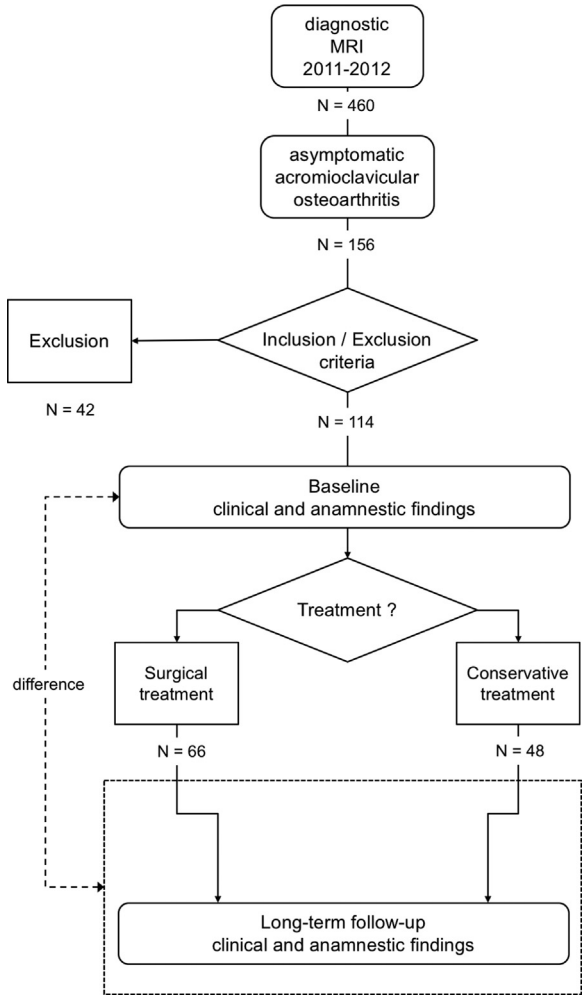

Figure 1 Inclusion and exclusion criteria of patients.

Table I Findings at baseline

	All	SURG	CONS	*P*
Age (yr)				.170
n	114	66	48	
Percent	100	58	42	
Mean	47.62	45.71	50.25	
SD	17.35	17.93	16.33	
Range	16-81	16-75	16-81	
Sex				.150
Male				
n	84	52	32	
Percent	73.7	78.8	66.7	
Female				
n	30	14	16	
Percent	26.3	21.2	33.3	
Physical demand on shoulder				.620
Grade I [0]				
n	61	35	26	
Percent	54	53	54.2	
Grade II [1]				
n	21	10	11	
Percent	18	15.2	22.9	
Grade III [2]				
n	32	21	11	
Percent	28	31.8	22.9	
T_2 signal increase				.490
Distal clavicular region				
n	16	8	8	
Percent	14.0	12.2	16.7	
Acromial region				.110
n	18	9	9	
Percent	15.8	13.6	18.8	
Shubin Stein AC-OA[20]				.090
Grade I				
n	44	28	16	
Percent	38.6	42.4	33.3	
Grade II				
n	21	14	7	
Percent	18.4	21.2	14.6	
Grade III				
n	31	17	14	
Percent	27.2	25.8	29.2	
Grade IV				
n	18	7	11	
Percent	15.8	10.6	22.91	
Constant score (0-100)[2]				.027
Mean	72.5	68.8	77.6	
SD	21.1	21.42	19.62	
Follow-up years				.740
Mean	7.07	7.08	7.04	
SD	0.73	0.79	0.63	

SD, standard deviation; *AC-OA*, acromioclavicular osteoarthritis. Column *P* indicates the statistical significance of the difference between groups with shoulder operation (SURG) and conservative treatment (CONS) for other reason than AC-OA.

Table II Treatments: surgical and conservative therapies for the shoulder at baseline.

Initial treatment	SURG	CONS
	66 (58%)	
Physiotherapy and/or anti-inflammatory drugs and/or intra-articular corticoids		48 (42%)
Intra-articular corticoids		17 (15%)
Subacromial decompression	37 (32%)	
Rotator cuff refixation	38 (33%)	
Stabilization	17 (15%)	
Rotator cuff refixation + stabilization	2 (<2%)	
Shoulder prosthesis	3 (<3%)	

they had pain on palpation of the AC-joint (an instruction image was sent to all patients), what their pain level was, and if they had any therapies for the shoulder during the follow-up. If they were free of symptoms, the follow-up was completed at this point. In case of symptoms, patients were asked for a visit to the hospital and the follow-up was completed by a clinical examination by one of the orthopedic surgeons.

Therapy for the involved shoulder at baseline

Treatment options were conservative therapy (group CONS, 42%) such as anti-inflammatory drugs and/or intra- or peri-articular corticoids (1-3 injections at an interval of at least 3 months) and/or physiotherapy, or surgical therapy (group SURG, 58%) with subacromial decompression, rotator cuff refixation, surgical stabilization, and shoulder prosthesis (Table II).

Stratification

Patients were stratified as receiving surgical treatment of the primary condition (SURG) or receiving conservative or no therapy (CONS) (Table III), presenting a clavicular T_2 signal increase at baseline (T2CL) (Table IV), presenting an acromial T_2 signal increase at baseline (T2AC) (Table V) according to AC-OA grade.[19] Physical demand (grade I = low demand, e.g., office work, hiking; grade II = medium demand, e.g., household/bench work, skiing; grade III = high demand, e.g., building site/overhead work, tennis/throwing).

Endpoints

At baseline and at follow-up, the following 3 parameters were assessed:

1. visual analog scale pain part of the Constant score (CS-VAS, with 0-15 points, 15 = no pain, 0 = maximal pain)[2]
2. the presence of pain on ACJ compression (yes or no)[12]
3. the cross-body adduction test (positive or negative)[9]

The Constant score (CS)[2] ranging from 0 to 100 was also assessed at baseline but not used for the follow-up because it is not

Table III Clinical results at long-term follow-up

	All			SURG			CONS			*P* (SURG−CONS)	
	Baseline	Follow-up	*P*	Baseline	Follow-up	*P*	Baseline	Follow-up	*P*	Baseline	Follow-up
Pain on ACJ compression			.24			.79			.037	.21	.21
Yes											
n	12	18		9	8		3	10			
Percent	10.5	15.8		13.6	12.2		6.3	20.8			
No											
n	102	96		57	58		45	38			
Percent	89.5	84.2		86.4	87.9		93.8	79.2			
Cross-body adduction test			.017			.11			0.004	.45	.27
Positive											
n	7	23		5	11		2	12			
Percent	6.1	20.2		7.6	16.7		4.2	25			
Negative											
n	107	91		61	55		46	36			
Percent	93.9	79.8		92.4	83.3		95.8	75			
Constant score-VAS (0-15)			<.001			<.001			<.001	.78	.41
Mean	9.65	12.76		9.73	12.99		9.94	12.46			
SD	3.53	3.38		3.76	3.32		3.22	3.48			

ACJ, acromioclavicular joint; *VAS*, visual analog scale.
Column *P* indicates the statistical significance of the difference between groups with shoulder operation (SURG) and conservative treatment (CONS).

specific for the ACJ, and low values are obtained for other reasons than AC-OA.

The combined endpoint of this study was composed of 3 secondary endpoints as the difference from baseline to follow-up in the CS-VAS, pain on ACJ compression, and the cross-body adduction test. The combined endpoint was "worse" if *any two or all* of (1) a decrease in CS-VAS, (2) an increase in the frequency of pain on ACJ compression, and (3) an increase in the frequency of a positive cross-body adduction test were observed. The combined endpoint was "better" if *any two or all* of (1) an increase but no decrease in CS-VAS, (2) a decrease but no increase in the frequency of pain on ACJ compression, and (3) a decrease but no

Table IV Clinical results at long-term follow-up for patients with or without clavicular MRI signal enhancement

	T2CL pos			T2CL neg			*P* (T2CL pos−neg)	
	Baseline	Follow-up	*P*	Baseline	Follow-up	*P*	Baseline	Follow-up
Pain on ACJ compression			.63			.28	.78	.73
Yes								
n	2	3		10	15			
Percent	12.5	18.8		10.2	15.3			
No								
n	14	13		88	83			
Percent	87.5	81.3		89.8	84.7			
Cross-body adduction test			.28			.003	.98	.88
Positive								
n	1	3		6	20			
Percent	6.3	18.8		6.1	20.4			
Negative								
n	15	13		92	78			
Percent	93.8	81.3		93.9	79.6			
Constant score-VAS (0-15)			<.001			<.001	.07	.88
n	16	16		98	98			
Mean	8.19	12.88		9.89	12.75			
SD	3.39	3.42		3.51	3.39			

MRI, magnetic resonance imaging; *T2CL*, clavicular T_2 signal increase at baseline; *ACJ*, acromioclavicular joint; *VAS*, visual analog scale.
Column *P* indicates the statistical significance of the difference between groups.

Table V Clinical results at long-term follow-up for patients with or without acromional MRI signal enhancement

	T2AC pos			T2AC neg			*P* (T2AC pos−neg)	
	Baseline	Follow-up	*P*	Baseline	Follow-up	*P*	Baseline	Follow-up
Pain on ACJ compression			.63			.28	.93	.91
Yes								
n	2	3		10	15			
Percent	11.1	16.7		10.41	15.6			
No								
n	16	15		86	81			
Percent	88.9	83.3		89.6	84.4			
Cross-body adduction test			.15			.005	.91	.81
Positive								
n	1	4		6	19			
Percent	5.6	22.2		6.2	19.8			
Negative								
n	17	14		90	77			
Percent	94.4	77.8		93.8	80.2			
Constant score-VAS (0-15)			<.001			<.001	.2	.64
n	18	18		96	96			
Mean	8.67	13.11		9.83	12.7			
SD	3.58	3.29		3.51	3.41			

MRI, magnetic resonance imaging; *T2AC*, acromial T_2 signal increase at baseline; *ACJ*, acromioclavicular joint; *VAS*, visual analog scale.
Column *P* indicates the statistical significance of the difference between groups.

increase in the frequency of a positive cross-body adduction test were observed. The combined endpoint was ''equal'' if it was neither ''worse'' nor ''better.''

Statistics

Statistics was performed by an independent professional biostatistician of the Clinical Trial Center of the author's university using the R programming language. Descriptive statistics was used for all participants' data. Parametric statistics was used for continuous data (CS-VAS) such as mean, standard deviation (SD), and independent and dependent Student's *t*-test. Nonparametric statistics (frequency, chi-square test) was used for discrete data such as pain on ACJ compression and cross-body adduction test.

Because descriptive statistics revealed only few cases with a worse or better combined endpoint and because the study hypothesis was many of the asymptomatic patients becoming worse, the endpoint values ''better'' and ''equal'' were combined to strengthen the statistical explanatory power. Odds ratios for age, gender, physical demand, MRI signal enhancement, AC-OA grade, and treatment of the primary condition (SURG/CONS) on the combined endpoint are reported.

Results

Baseline

The prevalence of primary asymptomatic AC-OA in our patient group was 34% (156/460). The mean age at baseline was 47.6 years (n = 114, SD = 17.4; range, 16-81 years); 26% were female and 74% male (Table I). Physical demand on shoulders was grade I in 54%, grade II in 18%, and grade III in 28% (Table I). MRI examinations at baseline revealed an increased T_2 signal intensity in the distal clavicular region in 14% and in the acromial region in 16% (Table I). Shubin Stein AC-OA grade I was detected at baseline in 39%, grade II in 18%, grade III in 27%, and grade IV in 16% (Table I). Pain on ACJ compression was found in 11% and the cross-body adduction test was positive in 6% (Table I). The mean CS-VAS was 10 (SD = 3.5). A conservative treatment of the primary condition received 42% (n = 48) of the patients (group CONS) and 58% (n = 66) received a surgical therapy (group SURG, Table I). Table II shows the treatments for the shoulder at baseline. The groups SURG and CONS did not differ regarding age and gender, physical demand, MRI signal enhancement, or AC-OA grade (Table I).

Mid-term follow-up

The mean follow-up interval was 7 years (SD = 0.73, Table I).

Pain on ACJ compression

Pain on ACJ compression was found in 16% of all patients, and this was higher than at baseline (11%, $P = .240$). MRI signal enhancement at baseline in the clavicle or acromion and the treatment of the primary condition (SURG or

CONS, Table III) had no influence on ACJ compression (Tables IV and V).

Cross-body adduction test

The cross-body adduction test was positive in 20% of all patients and was higher than at baseline with 6% ($P = .017$). MRI signal enhancement at baseline in the clavicle or acromion and the treatment of the primary condition (SURG or CONS, Table III) had no influence on the cross-body adduction test (Tables IV and V).

CS-VAS

The mean CS-VAS was 13 (SD = 3.38) at follow-up and was higher than at baseline with 10 (SD = 3.53, $P < .001$), indicating less pain. MRI signal enhancement at baseline in the clavicle or acromion and the treatment of the primary condition (SURG or CONS, Table III) had no influence on the CS-VAS (Tables IV and V).

Combined endpoint

Regarding the combined endpoint, the asymptomatic AC-OA remained asymptomatic over the 7-year course in 83% of cases, 7% turned better, 10% turned worse. Males had a 4 times lower risk than women to develop a worse outcome. A higher physical demand increased the chance for a worse outcome by a factor of 2.9. MRI signal enhancement in the distal clavicle or acromion had no influence on outcome. AC-OA grade 2 according to Shubin-Stein had no influence on outcome, but grades 3 and 4 showed 2 to 4 times increased risk for a worse outcome.

Therapies

Therapies during follow-up included physiotherapy and pain medication in 21% and only 1 case (0.9%) required an AC resection.

Discussion

This is the first systematic evaluation of the natural mid-term course of AC-OA over 7 years in shoulder patients presenting at an orthopedic department of a public hospital. Our main finding was that 90% of patients remained asymptomatic and only 1 of 114 patients required an ACJ resection.

Our findings are not unexpected, as the literature reports frequent radiological findings in MRI imaging compatible with AC-OA in asymptomatic individuals.[3,8,10,20] In a short-term follow-up of 2 years in patients with rotator cuff repair, no relationship between clinical findings and MRI appearances of AC-OA was found.[3,13,14]

Some authors recommend preventive distal clavicle resection because they obtained better results in combination with rotator cuff repair,[7,16] whereas others do not recommend it because distal clavicle resection did not improve results after 2 years.[13,14] In contrast, any procedure involving the ACJ is a risk factor for late onset ACJ pain with a complication rate up to 39%.[4,8,13,14] Patients with distal clavicle resection for asymptomatic AC-OA performed simultaneously with rotator cuff repair in 27% had sustained ACJ symptoms, pain, and symptomatic AC instability.[13,14] On the other hand, in patients without distal clavicle resection 80% showed an improvement in ACJ symptoms, although the radiographs showed a progression of AC-OA and only 16% had residual ACJ tenderness after 2 years.[14] Only 3.8% developed ACJ pain during a follow-up of 32 months and 1.9% underwent reoperation for additional distal clavicle resection.[7] Even in case of a positive Lidocaine injection test for AC-OA, in a randomized controlled trial of rotator cuff repair, preserving the ACJ did not affect results over 2 years.[3,13]

It is unclear whether MRI findings correlate with clinical symptoms: Jordan et al[6] analyzed 119 MRIs and reported findings such as osteophytes, fluid in and outside the joint, irregularity of joint margins, and found no correlation between MRI appearance and clinical findings of the ACJ. In an asymptomatic AC-OA group, Shubin Stein et al[19] observed grade I in 18%, grade II in 66%, grade 3 in 12%, and grade 4 in 4%, which differs from our observations (I: 39%, II: 18%, III: 27%, IV: 16%). We attribute this to a dissimilar patient selection: the asymptomatic group of Shubin Stein et al[19] consisted of 50 patients with no history of shoulder symptoms, whereas all of our 114 patients had shoulder symptoms and were only asymptomatic for the AC joint. This could explain the increased incidence of higher AC-OA grades in our cohort. Shubin Stein et al[19] also reported that 80% of symptomatic and 0% of asymptomatic patients had reactive bone edema. Therefore, the question arises whether MRI signal enhancement is a more sensitive parameter for symptomatic AC-OA. Our results do not support this notion. Contrary to Shubin Stein et al,[19] in our asymptomatic patients, we found in 14% an MRI signal enhancement in the clavicle and in 16% in the acromion. Thus, bone marrow edema is not a finding unique to symptomatic patients. This is also supported by findings of Jordan et al,[6] who found a high signal in the distal clavicle in 17% and found no influence of high signal on clinical findings.

Our prevalence of primary asymptomatic AC-OA was 34% even though we not only included grades 2-4 as AC-OA, but also used MRI signal enhancement as a more sensitive criteria. Shubin Stein et al[20] reported a higher prevalence of 82% on MRI in asymptomatic patients. We attribute this to patient selection and chance as Shubin Stein measured 50 patients without giving selection details. We included all 460 MRIs of the Shoulder and Elbow Surgery

Department of our tertiary hospital during a limited, defined time period.

We found an increased risk for a worse outcome in males, which, however, is not supported by Pennington who found no influence of gender on AC-OA.[17] Physical demand had a 2.9 times higher risk for a worse outcome in our study. This is supported by the literature as avoidance of repetitive, aggravating overhead and cross-body motions such as pushing, weight lifting, throwing, or overhead work can also relieve pain.[8] Shubin Stein et al[19] described a higher OA grade and MRI signal enhancement in symptomatic compared with asymptomatic patients. We and Jordan et al,[6] however, could not find an influence of high signal on clinical symptoms. The AC-OA grades 3 and 4 were associated with 2 to 4 times higher risk for a worse outcome, which is supported by the findings of Shubin Stein et al, who found a higher OA grade in symptomatic patients.[19]

Even though physical therapy as a part of conservative treatment is reported to have little or no effect,[1,5,8] it has been used in our study in 21% and seems to have helped staying asymptomatic. As a limitation, physical therapy has been prescribed for anterosuperior shoulder pain that is a complex problem often caused by subacromial impingement or rotator cuff tear.[5,20] It is difficult to clinically separate pain symptoms specifically attributable to the ACJ from pain attributable to rotator cuff pathology.[8,16] One of our patients had to undergo a secondary distal clavicle resection (1/114, 0.9%), which is a rate comparable with the literature (1.9% after 2.7 years).[6]

This study has the following limitations: (1) On one side, using telephone interviews for follow-up may be considered a drawback,[11] but on the other side the number of patients that could be followed up was higher (100%). This is especially meaningful because 90% of patients had an outcome equal to or better than at baseline and therefore, being asymptomatic, were more difficult to be convinced to travel to the hospital merely for research purposes. This is particularly true for a tertiary hospital that is central in a mountainous region with a considerable number of patients from far and wide. (2) Many of our patients also had shoulder pathology other than AC-OA, which poses a challenge in telephone interviews to retrieve accurate data of actual pain origin. (3) The results for all included patients revealed no deterioration of AC-OA symptoms; indeed, a minor but statistically significant improvement in the subjective pain experience measured by CS-VAS was even evident. This parameter is not solely dependent on AC-OA, as shoulder pain may also be due to other shoulder structures or to the surgical intervention. This would, however, only have to be taken in account if deterioration of pain was evident. (4) We have used our own grading system for physical demand because no other grading systems appropriate for the purpose of this study were available. This grading system has not been validated or published so far. (5) The follow-up is only 7 years. A long-term follow-up of 10-15 years should rise the level of significance and may confirm or not the observed trend of deterioration of ACJ compression and cross-body adduction test.

The strength of this study is the high number of patients (460) with 114 fulfilling the inclusion criteria.

Conclusion

Our results allow us to dismiss the working hypothesis: asymptomatic AC-OA diagnosed by MRI will become symptomatic in the mid-term because 90% of the patients remained asymptomatic. In line with the literature, it can be concluded that AC-OA diagnosed by MRI in asymptomatic patients does not justify prophylactic, concomitant surgical therapy of the ACJ in otherwise indicated surgical interventions. Surgery for ACJ pathology associated with radiologically diagnosed AC-OA should only be considered if patients are symptomatic and verified clinically, and if conventional therapy fails.

Disclaimer

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