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ORIGINAL STUDY

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Clinical and MRI outcomes of subacromial impingement syndrome with conservative treatment: a 21-month prospective study

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Background: Information is lacking on the natural history of early stages of degenerative rotator cuff disease. Such information can be obtained by using clinical and imaging assessment after conservative treatment in affected patients.

Hypothesis: Subacromial impingement syndrome is a clinical presentation that can be associated with early stages of the disease. We aimed to describe the natural history of degenerative rotator cuff disease from the early stages by studying clinical and imaging outcomes in non-operated patients with subacromial impingement syndrome.

Patients and methods: Patients with subacromial impingement syndrome were prospectively included. They had conservative treatment and were assessed before treatment and during at least 12-month follow-up. Assessment included clinical evaluation on a 0- to 100-point Constant scale and subscales as well as MRI of the rotator cuff. Clinical results were compared to baseline MRI findings and according to lesional progression.

Results: We included 26 patients with mean age 59.1 (SD 9.6), mean pain duration 23.1 (31.3) months; mean total Constant score 39.1 (12.1). Overall, 9 patients had no tear, 9 had a partial tear and 8 had a full-thickness tear. Mean follow-up was 21 (SD 10) months. Total Constant score and subscores improved at follow-up in the overall sample. Patients without tear and those with partial or full-thickness tear at baseline showed clinical improvement. MRI of the rotator cuff at follow-up indicated lesional worsening in 7 patients. However, clinical improvement did not differ by lesional progression or not.

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Conclusion: We report on 21-month clinical and MRI assessments of degenerative rotator cuff disorders including early stages of the disease. Clinical improvement was not related to MRI changes over time. Further investigations are needed to verify our findings in larger study populations.

Keywords: sub-acromial impingement; degenerative rotator cuff disease; shoulder; natural history; radiology; MRI.

INTRODUCTION

Shoulder disorders are frequent in adults (*1-4)*. Degenerative rotator cuff disease is the most common shoulder malady *(5)*. Anatomical lesions of degenerative rotator cuff disease include subacromial bursitis, tendinopathy, and partial and full-thickness tears *(6)*. Cross-sectional studies suggested that degenerative changes of the rotator cuff naturally occur with aging and may be observed in both symptomatic and asymptomatic populations *(7)*. Longitudinal studies with clinical and imaging assessments described anatomo-clinical outcomes with conservative treatment *(8-15)*. They agree with the hypothesis of anatomo-clinical dissociation as a particular feature in the natural history of degenerative rotator cuff disease, showing that clinical improvement may be associated with lesional worsening. However, most investigations focused on full-thickness tears. They did not consider early stages of the disease.

We aimed to describe the clinical and imaging outcomes of early stages of degenerative rotator cuff disease. Subacromial impingement syndrome is a clinical presentation that can be associated with early stages of the disease *(10,16-18)*. Therefore, we conducted a longitudinal study with clinical and MRI assessments of non-operated patients with subacromial impingement syndrome.

METHODS

Design

This was an ancillary study of a previously reported prospective trial 19. The trial was approved by an ethics committee. All patients gave their written consent before participating.

Patients

Patients consulting in the rheumatology department of our institution because of degenerative rotator cuff disease and fulfilling the inclusion and exclusion criteria were invited to participate in the study. Inclusion criteria were age > 30 years; shoulder pain duration ≥ 1 month; positive results for at least 2 impingement tests among Neer, Yocum, and Hawkins tests; and total Constant score < 80. We excluded the following shoulder conditions: reduced passive range of motion, instability, tendinous calcifications, gleno-humeral osteoarthritis, corticosteroids injection in the last month, previous shoulder surgery, humeral fracture, inflammatory arthritis and neoplastic disorders.

Treatment

Patients had conservative treatment. They all underwent supervised physiotherapy including 15 outpatient sessions and home exercises. Oral analgesic and nonsteroidal anti-inflammatory drugs and subacromial injections of corticosteroids were given as necessary.

Outcomes

Patients were assessed before treatment and at least at 12-month follow-up. In patients with bilateral shoulder pain, only the more painful shoulder was considered. Assessment included clinical and MRI evaluations.

Clinical evaluations were performed by the same physician (JB). Clinical outcomes were scores on the 0- to 100-point Constant scale and its subscales for pain (0 to 15 points), activity (0 to 20 points), mobility (0 to 40 points) and strength (0 to 25 points) *(20)*. Higher scores indicated lower disability.

MRI of the shoulder included T1- and T2-weighted fast spin-echo sequences in the axial, coronal and sagittal planes. All MRI images were reviewed by the same experienced musculo-skeletal radiologist (DP). The findings were classified as normal tendon, tendinopathy without tear, partial-thickness tear and full-thickness tear *(21,22)*. In case of partial-thickness tear, bursal, intra-tendinous and articular-side locations were recorded. Full-

thickness tears were classified according to a 0- to 5-point retraction grading in the coronal plane *(23)*. Effusion and thickening of the subacromial bursa were recorded as subacromial bursitis. For each shoulder, the MRI diagnosis of rotator cuff disorder was established according to the highest level of abnormality and the tendon involved: supraspinatus, infraspinatus, or subscapularis. The order of abnormality by increasing level was as follows: normal tendon and bursa, subacromial bursitis, tendinopathy, partial tear and full-thickness tear. Lesional progression at follow-up was defined as a higher-level abnormality of the tendon at the final MRI versus baseline MRI and also took into account the retraction of the full-thickness tear in the coronal plane and the number of affected tendons.

Statistical method

Quantitative variables are expressed as means and standard deviations (SD). Categorical variables are expressed as numbers. Comparisons involved quantitative variables and were according to baseline diagnosis and lesional progression. For baseline diagnosis, 3 groups were considered: no tear, partial tear and full-thickness tear. No tear included normal tendons, subacromial bursitis and tendinopathy. For lesional progression, we compared progression and no progression groups. The Wilcoxon test was used to compare baseline and follow-up data. Mann-Whitney and Kruskal Wallis tests were used as required to compare 2 or more groups. Mean differences and corresponding 95% confidence intervals (CIs) are reported for continuous variables between baseline and follow-up. Statistical analysis involved use of Statview v4.5 (Abacus Concepts, Berkeley, CA). $P < 0.05$ was considered statistically significant.

RESULTS

We included 26 patients. Mean time between clinical and MRI assessments was 1 (SD 1) month. Characteristics of the study population are in Table I. Nine patients had no tear. The diagnoses were normal tendons and subacromial bursa (n=1), subacromial bursitis (n=3), and supraspinatus tendinopathy (n=5). Nine patients had a partial tear: bursal supraspinatus tear (n=4), bursal infraspinatus tear (n=2), intratendinous infraspinatus tear (n=1), articular supra- and infraspinatus tear (n=1), and bursal supraspinatus tear with intra-tendinous infraspinatus tear (n=1). Eight patients had a full-thickness tear: supraspinatus tear with retraction

Table I. – Baseline characteristics of the study population (n=26)

Age, years, mean (SD)	59.1 (9.6)
Women, n (%)	21 (81.8)
Dominant shoulder, n (%)	18 (69.2)
Manual workers, n (%)	4 (15.4)
Sport with upper limb, n (%)	6 (23.1)
Work injury, n (%)	0
Pain duration, months, mean (SD, range)	23.1 (31.3, 1-120)

Table II. – Clinical results in the study population (n=26)

Constant score, mean (SD)	Baseline	Final	Difference, mean [95% CI]	P value
Pain, 0-15	6.9 (2.9)	10.9 (3.7)	4.0 [2.9; 5.1]	<0.0001
Activity, 0-20	10.3 (3.5)	15.3 (4.7)	5 [3.4; 6.6]	<0.0001
Mobility, 0-40	16.4 (5.4)	27.5 (10.9)	11.1 [7.8; 14.4]	<0.0001
Strength, 0-25	5.5 (6.1)	8 (3.2)	2.5 [1.2; 3.8]	<0.0016
Total, 0-100	39.1 (12.1)	62.1 (21.5)	23 [17.2; 28.8]	<0.0001
95% CI, 95% confidence interval				

grade 0 to 3 (n=7) and supra- and infraspinatus tear with retraction grade 3 (n= 1).

Mean follow-up was 21 (SD 10) months. Constant score and subscores for pain, activity, mobility and strength improved at follow-up in the total study sample (Table II). Patients without tear and those with partial or full-thickness tear showed clinical improvement according to most outcome criteria (Table III). Improvement of activity subscores was lower with full-thickness tears than no tears or partial-thickness tears. We found no other differences in clinical improvement according to baseline diagnosis of degenerative rotator cuff disorder.

The 9 patients without tear showed no lesional progression at follow-up. Six of the 9 patients with partial tears showed lesional progression to a full-thickness tear at follow-up. Two bursal supraspinatus tears, 1 infraspinatus tear and 1 supraspinatus tear with intratendinous infraspinatus tear led to a full-thickness supraspinatus tear. One bursal infraspinatus tear and 1 articular supra- and infraspinatus tear led to a full-thickness supra- and infraspinatus tear. One of the 8 full-thickness tears showed lesional progression at follow-up: a full-thickness supra- and infraspinatus tear in which retraction worsened from grade 3 to 4.

Clinical results according to lesional progression are in Table IV. Patients with or without lesional progression showed clinical improvement at follow-up, with the exception of strength subscores for those with lesion progression. Clinical improvement did not differ by lesional progression.

DISCUSSION

Our study provides information related to the natural history of degenerative rotator cuff disease in patients with subacromial impingement syndrome. Observations from early stages of the disease are therefore of particular value because they are rarely reported elsewhere. We found

Table III. – Clinical results according to baseline MRI diagnoses

	No tear	Partial tear	Full-thickness tear	P value
n	9	9	8	
Constant score, mean (SD)				
Pain, 0-15				
Baseline Final Difference [95%CI]	5.8 (2.8) 10.1 (4.4) 4.4 [1.9; 6.5]	6.8 (2.6) 11.8 (2.8) 4.9 [3.3; 6.5]	8.4 (3.1) 10.9 (4.1) 2.5 [0.6; 4.4]	0.17 0.74 0.25
Activity, 0-20				
Baseline Final Difference [95%CI]	9 (1.3) 15.8 (5.0) 6.8 [4.1; 9.5]	10.3 (3.6) 17 (3) 6.7 [5.1; 8.3]	11.7 (4.7) 13 (5.5) 1.2 [-1.1; 3.5]	0.40 0.43 0.007
Mobility, 0-40				
Baseline Final Difference [95%CI]	14 (4.1) 25.6 (9.9) 11.6 [6.2; 17]	16.2 (4.5) 27.6 (11.7) 11.3 [4; 18.6]	19.2 (6.8) 29.5 (12.0) 10.2 [5.7; 14.7]	0.12 0.72 0.86
Strength, 0-25				
Baseline Final Difference [95%CI]	5.1 (6.3) 7 (6.2) 1.8 [-0.1; 3.7]	6.6 (7.6) 10.4 (8.9) 3.8 [0.9; 6.7]	4.7 (4.2) 6.5 (5) 1.8 [-0.1; 3.7]	0.96 0.70 0.53
Total, 0-100				
Baseline Final Difference [95%CI]	33.9 (10.8) 58.4 (21.3) 24.6 [13.9; 35.3]	40.0 (11.8) 66.7 (22.5) 26.8 [17.7; 35.9]	44.1 (12.7) 61.1 (22.4) 17.1 [7.1; 27.1]	0.22 0.68 0.37
95% CI, 95% confidence interval				

Table IV. – Clinical results according to MRI progression of rotator cuff disorders over time

	No MRI progression	MRI progression	P value
n	19	7	
Constant score, mean (SD)			
Pain, 0-15			
Baseline Final Difference [95%CI]	6.8 (2.9) 11.1 (4.2) 4.3 [2.9; 5.7]	7.2 (3.6) 10.6 (2.2) 3.3 [2; 4.6]	0.52 0.62 0.40
Activity, 0-20			
Baseline Final Difference [95%CI]	10.6 (3.5) 15.3 (5.0) 4.7 [2.7; 6.7]	9.4 (3.6) 15.4 (4.1) 6.0 [3.7; 8.3]	0.73 0.79 0.60
Mobility, 0-40			
Baseline Final Difference [95%CI]	15.9 (5.9) 26.8 (10.6) 10.9 [7.6; 14.2]	17.7 (4.1) 29.1 (12.2) 11.4 [2.4; 20.4]	0.45 0.52 0.52
Strength, 0-25			
Baseline Final Difference [95%CI]	5.5 (5.5) 8.4 (7.3) 2.9 [1.2; 4.6]	5.4 (8) 7.0 (6.3) 1.6 [-0.4; 3.6]	0.69 0.79 0.52
Total, 0-100			
Baseline Final Difference [95%CI]	38.9 (12.7) 62.1 (22.6) 23.3 [16; 30.3]	39.8 (11.1) 62.1 (19.9) 22.2 [13.2; 31.2]	0.84 0.98 0.79
95% CI, 95% confidence interval			

subacromial impingement syndrome, a clinical presentation, associated with a wide spectrum of MRI findings, including normal cuff, subacromial bursitis, tendinopathy, and partial and full-thickness tears. Patients with subacromial impingement syndrome showed clinical improvement according to Constant score and subscores at almost 2-year follow-up. For 7, MRI of the rotator cuff indicated lesional worsening between baseline and follow-up. We did not observe any difference in clinical outcomes according to rotator-cuff MRI changes.

Surgical and imaging observations had indicated that pathological findings associated with subacromial impingement syndrome include subacromial bursitis, tendinopathy, and partial and full-thickness tear of the rotator cuff *(16-18,24,25)*. In accordance with previous reports, most of our patients had no tear or only a partial tear, which can be considered early stages of degenerative rotator cuff disease *(16-18,25)*. Four of our patients had a normal rotator cuff on MRI. Three of these had subacromial bursitis, which could account for the shoulder pain. Some reports indicated that a few patients with subacromial impingement syndrome can exhibit no abnormality on MRI or on arthroscopy *(17,18,24)*, as we found in one patient.

Few studies have reported the long-term clinical outcome of subacromial impingement syndrome with conservative treatment *(10,26,27)*. Our results showing improvement of Constant score and subscores for pain, activity, mobility and strength after a 21-month period agree with others. We found only a few associations between clinical improvement and baseline MRI diagnosis. The subscore for activity showed the poorest improvement with full-thickness tears. Clinical outcome according to the aspect of the rotator cuff in non-operated patients with subacromial impingement syndrome has not been investigated. The tear size did not predict clinical outcome after conservative treatment in one cohort of patients with full-thickness tear *(28)*.

The accepted stages of rotator cuff disease are subacromial bursitis, tendinopathy, and partial and full-thickness tear *(6)*. Slow progression across stages is suggested by cadaveric and imaging studies *(7)*. Our longitudinal study revealed 7 cases of lesional progression on MRI at about 2-year follow-up. Indeed, 6 partial tears evolved to a full-thickness tear, and one full-thickness tear increased in size. Four longitudinal imaging studies examined concomitant baseline and final clinical assessment *(8,10,13,14)*. One study assessed patients with untorn tendinopathy 10 and found clinical improvement and no tear at 40-month follow-up. Two studies assessed patients with partial tear *(8,13)*: they showed clinical improvement and also concomitant lesional progression in 24% to 80% of patients at 14- to 46-month follow-up. Patients with or without worsening tear at follow-up showed improvement and clinical results did not differ between progression and no progression groups. One study included patients with partial or full-thickness tear *(14)*. It described a trend to clinical improvement, as mean tear size increased over time, and 42% of patients showed lesional worsening. Hence, our observations agree with previous findings: our patients showed clinical improvement, even those with worsened imaging results.

However, we underline some limitations. Our sample size was small, for low-powered comparisons between MRI-based categories. Further investigations in larger samples are needed. We used MRI rather than surgery for a reference method to diagnose rotator cuff disorders. Surgery would have been considered the gold standard. However, surgery was not indicated for our patients. Large series assessing the diagnostic value of MRI in degenerative rotator cuff disorders, with surgery as a reference criteria, reported suitable accuracy for full-thickness and partial tears *(29-31)*. In addition, the diagnostic value of MRI images in degenerative rotator cuff disorders is reinforced when read by experienced radiologists, as in our study. Finally, our results apply to a patient population from a rheumatology department with sub-acromial impingement syndrome defined as a painful shoulder with at least 2 positive test results among Neer, Hawkins and Yocum tests. The external validity of our findings needs to be reinforced in further investigation.

CONCLUSION

In conclusion, we report on 21-month clinical and MRI assessments of degenerative rotator cuff disorders including early stages of the disease, which have rarely been investigated. We found clinical improvement that was not related to MRI changes over time. Further investigations remain necessary to verify our findings in larger study populations.

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