Arthroscopic surgery versus supervised exercises in patients with rotator cuff disease (stage II impingement syndrome): A prospective, randomized, controlled study in 125 patients with a $2^1/_2$-year follow-up

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The effectiveness of arthroscopic surgery, supervised exercises, and placebo was compared in 125 patients with rotator cuff disease (impingement syndrome stage II) in a randomized clinical trial. The median age was 48 years, and the median duration of complications was 1 to 2 years. The treatments were arthroscopic subacromial decompression performed by 2 experienced surgeons, an exercise regimen supervised for 3 to 6 months by 1 experienced physiotherapist, or 12 sessions of detuned soft laser (placebo) for 6 weeks. The criterion for success was a Neer shoulder score >80. Fifteen (50%) and 11 (22%) of the patients randomized to placebo and exercises, respectively, had surgery during the $2^1/_2$-year follow-up period and were classified as having failure with the treatments. The success rate was higher ($P < .01$) for patients randomized to surgery (26 of 38) and exercises (27 of 44) compared with the placebo group (7 of 28). The odds ratio for success after surgery compared with exercises was 1.5 (95% confidence interval 0.6 to 3.7; $P = .49$). Including all patients who underwent operation, the success rate in those not on sick leave (19 of 21) before surgery was higher compared with those on sick leave (18 of 36) (adjusted odds ratio 5.6 [1.2 to 29.2]). Similar results were observed for patients not receiving versus those receiving regular pain medication before surgery (adjusted odds ratio 4.2 [1.2 to 15.8]). (J Shoulder Elbow Surg 1999;8:102-11.)

Ischemia,[18] inflammation, and degeneration[32] are related to age and overload of the tendons of the short rotator muscles[15,25] and are present in rotator cuff disease. Impingement of the rotator cuff and the subacromial bursa during elevation increases pain and contributes to chronic changes.[22] Rotator cuff disease or the impingement syndrome[22] can be classified according to its progression: (1) acute inflammation (tendinitis/bursitis), (2) degeneration and chronic inflammation (tendinosis),[25] and (3) rupture and arthritis.[22]

Chronic inflammatory cells are present in the subacromial bursa[31,34] but not in the coracoacromial ligament.[20] Free nerve endings located in the subacromial bursa are suggested as the source of pain in patients with subacromial pain.[34,35] In addition, mechanoreceptors and free nerve endings distributed in the rotator cuff may elicit pain.[39]

Subacromial pain may reduce muscular force[5] and contribute to the dysfunctional movement pattern often observed in these patients. The subacromial space is narrowed by protraction and widened by retraction of the scapula.[36] Thus a dysfunctional movement pattern may contribute to chronic pain through impingement. Furthermore the activity of the supraspinatus and infraspinatus, teres minor, and subscapularis muscles reduced the subacromial pressure in an experimental study.[41]

The role of primary impingement as the major etiologic factor has been questioned.[12,16,25,28,41] Current techniques of acromion resection may not affect the structures that can enlarge the subacromial space,[12] and the subacromial pressure may not be reduced.[42]

A success rate between 50% and 99% has been reported after resection of the acromion is performed.[13,24,29,30] Poor results are described in patients on sick leave.[13] We have previously reported that a supervised exercise regimen or resection of the anterior acromion, subacromial bursa, and coracoacromial ligament improved rotator tendinosis equally, and either approach was significantly better than placebo at a 6-month follow-up.[8] The prognosis was poorer in patients receiving regular medication or those who were on sick leave.[3] The aim of this study was to compare results and describe prognostic factors in these patients at a $2^1/_2$-year follow-up.

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Table I Baseline characteristics of study population according to treatment group

	Arthroscopic surgery		Placebo laser		Supervised exercises	
	Intention to treat (*n* = 45)	Treatment different (*n* =14)	Intention to treat (*n* = 30)	Treatment different (*n* = 17)	Intention to treat (*n* = 50)	Treatment different (*n* = 17)
Mean age (yr)	48	52	48	45	47	43
(range)	(26-66)	(31-66)	(24-65)	(24-62)	(23-65)	(32-53)
Women	36	36	50	76	56	60
Duration of complication						
<6 months	18	36	17	12	12	18
6 months - 1 year	18	14	17	6	12	6
1-3 years	20	7	17	30	26	23
>3 years	44	43	48	52	50	52
Bilateral pain	29	33	13	20	30	45
Dominant arm affected	70	67	46	65	62	62
Shoulder pain affected by work	81	86	77	86	77	91
Professional education <3 years	65	29	62	87	64	64
Work with hand above head level	50	50	54	43	45	60
Emotional distress (mean score)	1.5	1.5	1.5	1.4	1.6	1.6
Taking analgesics	67	64	75	64	75	54
Sick leave	60	71	60	65	54	75
Mean Neer score at entry						
Overall	63.6	61.8	64.7	65.8	66.2	67.7
Pain	13.8	13.6	14.8	15.1	14.7	15.0
Function	22.3	21.9	22.1	22.5	23.0	23.3
Range of motion	17.5	16.3	17.8	18.2	18.5	19.4

Values are percentages unless stated otherwise.

MATERIAL AND METHODS

Selection of patients. Inclusion criteria were age 18 to 66 years, pain in the shoulder for at least 3 months resistant to outpatient physiotherapy and nonsteroid and steroid anti-inflammatory medication, dysfunction or painful arc on abduction, normal glenohumeral range of movement, pain on 2 of the 3 isometric or eccentric tests (abduction at 0° and 30° and external rotation),[9] and positive impingement sign and test.[22] Lignocaine (6 mL; 10 mg/mL) was injected anteriorly[9] into the subacromial space. The diagnosis was confirmed if pain was appreciably reduced on re-examination after 15 minutes.

Exclusion criteria were arthritis of the acromioclavicular joint, cervical root syndromes, rotator cuff rupture, glenohumeral instability, bilateral muscular pain with tenderness and severely decreased ability to relax the shoulder, neck, and temporomandibular joints on examination, and reluctance to accept 1 or more of the treatment regimens of the study. Glenohumeral instability was diagnosed if the patient had a history of traumatic luxation or performed overhand sports and had a positive apprehension or relocation test on examination after a positive impingement test was confirmed.

All eligible patients were informed about the 3 treatments: arthroscopic surgery, supervised exercises, or placebo laser. They were told that the placebo option was a new type of soft laser therapy. Treatments were allocated by the method of random permuted blocks. Of the total of 444 patients referred, 125 agreed to participate and signed informed consent. Reasons for exclusion are shown in Figure 1. Further details have been described previously.[6] The Ethics Committee for Medical Research in Health Region I of Norway approved the study.

Treatments. The average time between randomization and the first day of treatment was 2 months in all groups.

Two experienced orthopaedic surgeons at Menighetssøsterhjemmets Hospital performed the arthroscopic surgery. The aim of the procedure was to create more space for the rotator cuff so as to reduce the risk of impingement. Standard treatment consisted of bursectomy with resection of the anterior and lateral part of the acromion and the coracoacromial ligament. Postoperative rehabilitation was started on the first postoperative day. The exercises prescribed by the surgeon were performed against low resistance and repeated many times. Patients visited a physiotherapist where they lived, so several physiotherapists were engaged and somewhat different approaches were used. Unrestricted activities were usually allowed after 4 to 6 weeks.

The patients who were randomized to supervised exercises and placebo laser all were treated by the same experienced physiotherapist at the Department of Physical Medicine and Rehabilitation. The purpose of the supervised exercise regimen was to normalize dysfunctional neuromuscular patterns and to increase the nutrition of the rotator cuff collagen tissue.[7] To eliminate gravitational forces and start the exercises, the arm was suspended in a sling fixed to the ceiling. Relaxed repetitive movements (first rotation, then flexion and extension, and finally abduction and adduction) were

Table II Reasons treatment varied from that originally allocated

Reason	Original allocation to: Arthroscopic surgery (n = 14)	Placebo laser (n = 17)	Supervised exercises (n = 17)
Diagnosis changed	3	1	1
Adhesive capsulitis	1	1	1
Muscular pain	1*		
Synovial chondromatosis	1		
Condition improved	3		1*
Operated on		15†	11†
Had exercises	3	1*	
Did not attend for follow-up	5		4

*Did not attend for follow-up.
†Fifteen and 10 patients who did not improve with placebo laser and supervised exercises, respectively, had surgery. One patient did not attend supervised exercises but had surgery.

performed for approximately 1 hour in a daily training session. Patients were supervised twice weekly. On the other days they performed the same exercise program at home. Resistance was added gradually to strengthen the short shoulder rotator and the scapular stabilizing muscles. The training continued for 3 to 6 months, with supervision being gradually reduced. In addition, 3 lessons were given on the anatomy and function of the shoulder, pain management, and ergonomic advice. A training diary was used to motivate the patients and to guide the progression of the load and variety of exercises. A detailed description of the supervised exercise regimen is published elsewhere.[8]

Placebo treatment was given in 12 sessions of exposure to detuned soft laser, scheduled twice weekly.

In all treatment groups analgesics including anti-inflammatory drugs other than cortisone injections were allowed.

Follow-up. The study was primarily designed for a 6-month follow-up period. Blind follow-up measurements were carried out at 3 and 6 months.[6] At $2^1/_2$-year follow-up the examiner was not blinded for the treatment received. The patients were allowed to drop out of the study at any time but were encouraged to complete the 6-month follow-up. Thereafter those who were dissatisfied were allocated the treatment requested, usually surgery.

Outcome measures and predictors. The main outcome criteria was the Neer shoulder score.[2,23] This consisted of 4 parts: the patient scoring his or her pain during the previous week (verbal rating scale) (35 points), clinical testing of function (muscle strength, reaching, and stability) (30 points), active range of motion (25 points), and a radiologic evaluation (10 points). All radiographs were assessed as normal according to the Neer criteria, so the overall scale ranged from 10 to 100 points. The active range of motion was measured bilaterally with a goniometer at increments of 5° with the patient in the sitting position. To eliminate interobserver variability all tests were assessed by the same physician (JIB).

Secondary outcome variables were assessed by a standardized questionnaire filled in before the consultation. Patients scored their level of pain on activity, at rest, and at night the previous week on 9-point scales (1 = no pain, 9 = worst possible). Change of the main symptom was rated from +9 (best possible) to −9 (worst possible). Disability consisted of 16 categories of activity scored from 1 (low) to 7 (high).[4] For the purpose of this study 2 questions: "Can you carry a shopping bag (5 kg)?" and "Can you take down something from a wall cupboard?" were used as relevant indicators. These items correlated 0.68/0.70 with the mean item score.

The presumptive prognostic factors included age, sex, duration of disease, pain medication, professional education, sick leave, emotional distress, and isometric abduction endurance. Emotional distress was assessed by the 25-item Hopkins Symptom Check List.[10] Symptoms were rated from 1 (none) to 4 (severe). Isometric abduction endurance was recorded as the time the patients were able to hold their arms abducted at 45° with 2 kg-weight cuffs attached to each wrist.[4]

All prognostic factors were dichotomized. Patients were considered emotionally distressed if the average item score exceeded 1.74.[3] Pain medication was classified as regular when scored weekly or daily during the past year.

Statistical analyses. The results at 6 months were analyzed according to the method of intention to treat.[6] At $2^1/_2$-years the effect of randomization was diluted because many of the patients had had an additional treatment after the follow-up at 6 months (Table I, Figure 1). Therefore analyses were carried out both for the method of intention to treat and for the treatment received. For the purpose of intention to treat analysis, the Neer score at $2^1/_2$-years was classified according to Neer as excellent (90 to 100), good (80 to 89), fair (70 to 79), or poor (<70).[23] The patients who had surgery after they had undergone the placebo treatment or supervised exercise regimen were considered as having failure with the treatment randomized to and classified as poor. The Kruskal-Wallis 1-way analysis of variance rank test and the Mann-Whitney rank sum test were applied to detect significant differences among groups. To calculate the odds ratio for success, estimate 95% confidence intervals, and allow for adjustments for sex, sick leave, and pain medication, the Neer score was dichotomized with a cutoff at 80. Scores for pain and disability were dichotomized and considered successful if scores before randomization were reduced by more than 50% at follow-up.[30]

The score for mean change of the main symptom in

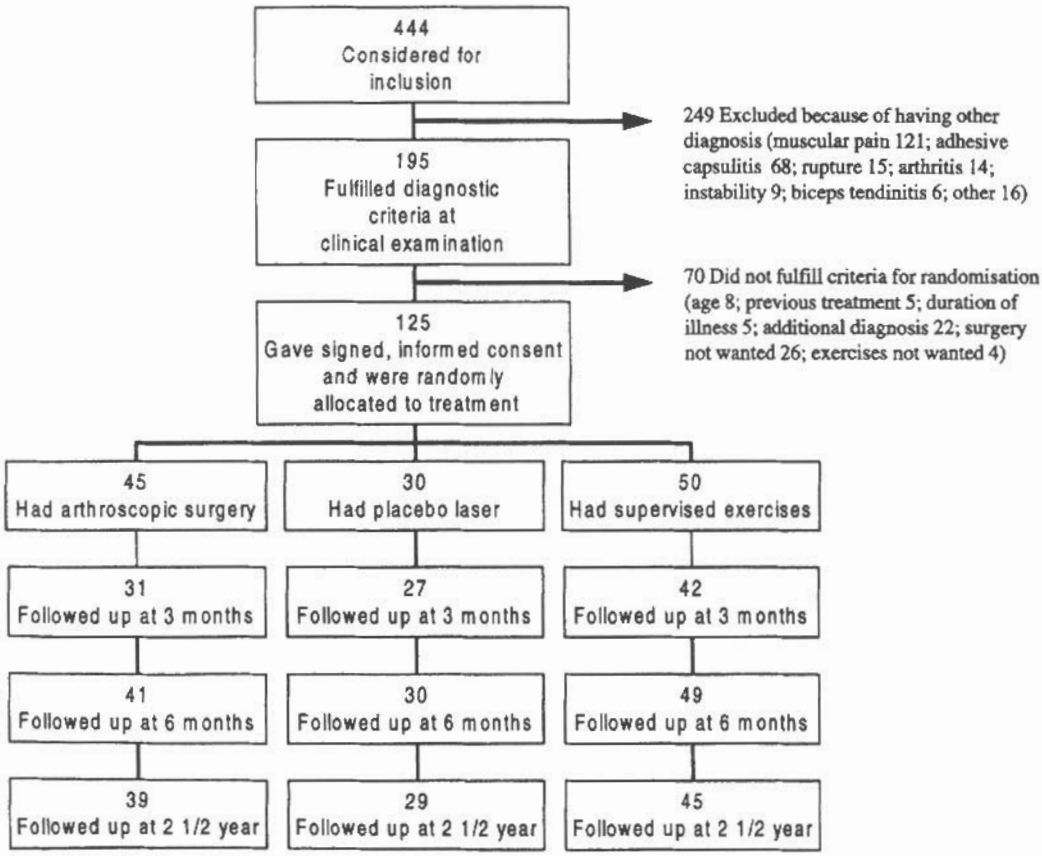

Figure 1 Recruitment and follow-up of patients.

those who had later surgery was set to 0 (unchanged). An independent *t* test was used to assess group differences. Multiple regression was applied to measure point estimates and confidence intervals after adjustment was done for sex, sick leave, and pain medication.

The Wilcoxon matched pair signed rank test was used for analyses within each group according to the treatment received. Logistic regression was applied for multivariate analysis of prognostic variables. Adjustments were made for age, sex, duration of symptoms, and pretreatment scores of pain on activity (not dichotomized).

RESULTS

Figure 1 shows that 113 (90%) patients were evaluated at a $2^1/_2$-year follow-up. Fifteen (50%) and 11 (22%) patients had surgery because of failed placebo laser or supervised exercises, respectively (Table II). There were 10 withdrawals from surgery, 7 attended $2^1/_2$-year follow-up, and 5 of those had a successful outcome. Five patients either did not attend exercises or dropped out after a few sessions, 3 of those attended $2^1/_2$-year follow-up, and outcome was successful in 2. One patient who had exercises had a cerebrovascular insult that involved the afflicted shoulder but reported no pain at follow-up.

Additional disease was observed in 8 patients who had surgery, synovial chondromatosis, rupture of the glenoid labrum (2 patients), partial rupture of the supraspinatus tendon (4 patients), or the biceps tendon. One patient from each of the 3 treatment groups (Figure 1) had diagnosed adhesive capsulitis after randomization but before treatment started. All patients who had an additional disease or adhesive capsulitis had a successful outcome.

Baseline characteristics of the patients are given in Table I. The percentage of women was low in the group randomized to surgery (36%) compared with that randomized to supervised exercises (56%). The 3 groups did not differ in age, duration of disease, whether the dominant arm was affected, percentage on sick leave, severity of disease, or degree of emotional distress. All patients had had at least 1 cortisone injection before inclusion. Although the median range of duration of disease was 1 to 3 years in all groups, 15% reported shoulder pain for less than 6 months before randomization. Duration of disease did not predict outcome, but the patients randomized to placebo who had later surgery had a longer duration than those who did not have surgery ($P = .02$; Fischer exact test). The mean age of the patients was 48 years, but 18% of the patients

Table III Neer score* at $2^1/_2$-year follow-up

	Arthroscopic surgery (n = 38†)	Placebo laser (n = 28†)	Supervised exercises (n = 44‡)
Excellent	22	4	23
Good	4	3	4
Fair	3	4	6
Poor	9	17§	11§

Results analyzed by the method of intention to treat. Values are numbers of patients.
Arthroscopic surgery - supervised exercises $P = .8$.
Arthroscopic surgery - placebo laser $P = .004$.
Supervised exercises - placebo laser $P = .02$.
*Excellent 90-100; good 80-89; fair 70-79; poor <70.
†One patient in each group who had diagnosed adhesive capsulitis before treatment start was excluded. The patient randomized to exercises did not attend follow-up.
‡One patient had surgery before treatment start and was excluded from analysis. Neer score was not measured in 1 patient who had a cerebrovascular insult. He had no pain at follow-up.
§Fifteen and 11 patients allocated placebo laser and supervised exercises, respectively, underwent operation. These patients were considered as having treatment failures and were classified as poor.

were younger than 35 years. The mean Neer score at a $2^1/_2$-year follow-up was 85.2 and 84.4 in patients younger and older than 35 years, respectively. Age did not influence outcome in any treatment group.

Intention to treat. Table III shows that only 7 of 28 patients given placebo had a good or excellent Neer score at $2^1/_2$-year follow-up. The results for surgery and exercises were 26 of 38 and 27 of 44 patients, respectively. The odds ratio for success according to the Neer score when adjusted for sex, pretreatment sick leave, and regular medication was 1.3 (95% confidence interval 0.8 to 2.2) after surgery compared with exercises, 6.6 (2.0 to 21.3) compared with placebo, and 4.8 (1.5 to 14.9) for exercises compared with placebo (Table V). The same tendency was found when secondary outcome variables (pain, disability, and mean change of main symptom) were compared (Table V).

The success rate was slightly lower for pain and disability in the exercise group. A significant ($P < .05$) difference between surgery and exercises appeared for the ability to take down things from a wall cupboard.

Treatment received. Median Neer scores in patients who had treatment as planned were 93.0 for surgery, 77.5 for placebo, and 94.5 for exercises at $2^1/_2$-year follow-up (Table VI). The difference among groups was not significant. None of the patients who had later surgery had a Neer score >80 at 6 months. The median Neer score improved after surgery in these patients and was 93 ($P < .001$) for placebo and 87 ($P < .01$) for exercises.

The outcome according to the Neer score was excellent or good at 6 months but fair or poor at a $2^1/_2$-year follow-up in 5 patients after surgery and 3 patients after exercises.

The improvement on secondary outcome variables showed the same tendency as for the overall Neer score, but pain on activity was less reduced in patients given placebo ($P < .05$) than in those who had surgery or performed the exercises (Table VI).

The reported change of main symptom improved ($P < .001$) from 6 months to $2^1/_2$-years in the patients randomized to placebo and exercises who had later surgery, but those who had surgery or exercises as planned did not improve after 6 months.

The number of patients on sick leave was reduced in all groups. The percentage receiving regular pain medication was reduced in all actively treated groups. The percentage receiving regular pain medication and on sick leave among those who had later surgery was markedly reduced after surgery (Table VI).

Prognostic factors. The patients randomized to exercises who had later surgery had a lower Neer score at 3 ($P < .05$) and 6 ($P < .001$) months compared with those who did not have later surgery.

Including all patients who underwent operation, the success rate in those not on sick leave before surgery (19 of 21) was higher than in patients on sick leave (18 of 36) (Table VII). Similar results were observed for patients not receiving pain medication (26 of 32) versus those receiving regular pain medication before surgery (11 of 25). The negative association between a successful outcome and pain medication or sick leave remained when age, sex, duration of disease, and initial pain on activity were adjusted for in multivariate analysis (Table VII).

Nineteen of 21 patients who had a disability pension before treatment, were unemployed, or had retired because of age had a Neer score >90 at a $2^1/_2$-year follow-up. Emotional distress, professional education, work with hand above level of head, isometric endurance, or complete pain relief versus pain relief on the Neer test was not significantly associated with outcome.

Table IV Secondary outcome variables

	Arthroscopic surgery (n = 38*)	Placebo laser (n =28*‡)	Supervised exercises (n = 45†‡)
Pain on activity	23 (19)	7 (6)	22 (19)
Pain at rest	24 (22)	6 (6)	22 (21)
Pain at night	24 (22)	6 (6)	23 (20)
Disability carry 5 kg at the side	23 (20)	5 (5)	21 (20)
Disability take down something from a wall cupboard	25 (24)	7 (6)	20 (19)

All differences between arthroscopic surgery and placebo laser were $P < .001$.
All differences between supervised exercises and placebo laser were $P < .01$.
All differences between arthroscopic surgery and supervised exercises were nonsignificant, except the ability to take down something from a wall cupboard ($P < .05$)
The number of patients who had >50% reduction of pain or disability (no pain or disability) at $2^1/_2$-year follow-up are given. Results were analyzed according to the method of intention to treat.
*One patient in each group had diagnosed adhesive capsulitis before treatment start and was excluded from analysis. The patient randomized to exercises did not attend follow-up.
†One patient had surgery before treatment start and was excluded from analysis.
‡Fifteen and 11 patients allocated to placebo laser and supervised exercises, respectively, underwent operation. These patients were classified as having treatment failures (<50% reduction of pain and disability).

Table V Unadjusted and adjusted* differences between treatments

	Arthroscopic surgery - supervised exercises		Arthroscopic surgery - placebo laser		Supervised exercises - placebo laser	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
Neer score	1.5(0.6-3.7)	1.3(0.8-2.2)	5.9(2.0-17.1)	6.6(2.0-21.3)	4.3(1.5-12.3)	4.8(1.5-14.9)
Pain on activity	1.7(0.7-4.2)	1.5(0.9-2.3)	4.5(1.6-12.8)	4.5(1.4-16.0)	2.9(1.0-8.1)	2.8(1.1-8.2)
Disability-carry 5 kg at the side	1.7(0.7-4.1)	1.5(0.8-2.5)	5.9(1.9-17.8)	6.0(1.8-19.9)	4.0(1.3-12.5)	4.1(1.2-13.5)
Mean difference in change of main symptom	0.8(-1.1-2.7)	0.5(-0.5-1.5)	3.3(0.8-5.6)	3.1(0.8-5 4)	2.7(0.7-4.7)	2.5(0.5-4.5)

Odds ratio and 95% confidence interval are given unless stated otherwise. Results are analyzed by the method of intention to treat.
*Adjusted for sex, pretreatment sick leave, and regular medication.

DISCUSSION

Our objective was to compare arthroscopic surgery and supervised exercises in patients with stage II impingement syndrome. Observed results at $2^1/_2$-year were better after surgery, but the difference between the 2 treatments was not statistically significant, and only minor changes were observed after 6 months. The large variation in outcome is reflected in the wide confidence intervals, but the difference between treatments was not significant when adjustment was done for probable confounders such as sex, pain medication, and sick leave.

The design of this study differed from current recommendations for treatment because it allowed for inclusion of young patients and patients with a short duration of symptoms. However, age and duration did not influence outcome and consequently did not bias results.

Rotator cuff disease, like many soft tissue lesions, offers few objective variables for use in follow-up studies. Lirette et al[21] reported that satisfactory results after anterior acromioplasty ranged from 37% to 80%, depending on the evaluation criteria chosen. Results in this study are based on the Neer shoulder score. This scale was designed for evaluation of displaced humeral fractures[23] but has been used to assess results after rotator cuff repair.[2] The validity of this scale has not been assessed, but in this study results were only slightly changed when a questionnaire including variables similar to the outcome measures recommended by Lirette et al[21] replaced the Neer score.

Although the patients included in this study had thorough clinical examinations, and strict clinical criteria were applied for inclusion, additional diagnoses such as partial supraspinatus rupture and injury of the glenoid

Table VI Main and secondary outcome variables

	Arthroscopic surgery	Placebo laser		Supervised exercises	
	Treatment as planned (*n* = 31)	Treatment as planned (*n* = 13)	Had surgery (*n* = 15)	Treatment as planned (*n* = 33)	Had surgery (*n* = 11)
Neer score					
Percent who had success*					
6 months	71	62	0	79	0
$2^1/_2$-years	68	54	67	79	55
Overall score† (10-100)					
Baseline	66	65	66	66.5	67
6 months	86	81.5	58	89	68
$2^1/_2$-years	93	81.5	91	94	87
Pain‡ (0-35)					
Baseline	15	15	15	15	15
6 months	30	25	15	30	15
$2^1/_2$-years	30	22.5	30	30	30
Function§ (0-30)					
Baseline	22	21	20	22	22
6 months	30	25	20	29	22
$2^1/_2$-years	30	26	28	30	28
Range of motion‖ (0-25)					
Baseline	19	18	18	19	20
6 months	23	21	15	23	21
$2^1/_2$-years	23	22.5	23	25	22
Secondary outcome variables					
Main symptom# (+9 to −9)					
Change 6 months	7.0	3.0	0.0	7.0	1.5
Change $2^1/_2$-years	7.0	6.0	7.0	7.0	8.0
Pain on activity¶ (1 - 9)					
Baseline	7.0	7.0	7.0	6.5	7.0
6 months	3.0	5.5	7.0	3.0	5.5
$2^1/_2$-years	2.5	4.0	2.0	2.5	2.0
Pain at night¶ (1 - 9)					
Baseline	4.0	4.0	5.0	5.0	5.0
6 months	2.0	3.0	5.0	2.0	4.5
$2^1/_2$-years	1.5	2.0	2.0	2.0	2.0
Percent receiving weekly pain medication					
Baseline	29	31	57	41	64
6 months	24	33	40	22	60
$2^1/_2$-years	17	33	29	18	25
Percent on shoulder-related absence from work					
Baseline	53	55	73	43	73
6 months	38	43	60	31	80
$2^1/_2$-years	41	36	20	20	27

Median scores are given unless stated otherwise.
Results are analyzed according to the treatment received.
*Score >80 = success.
†*Best possible* = 100.
‡No pain = 35.
§Normal function = 30.
‖Normal range of motion = 25.
#Best possible = 9.
¶No pain = 1.

labrum appeared in 8 patients on surgical examination. All of these patients had excellent results after surgery. We do not know the number and outcome of patients randomized to exercises who had similar diagnoses.

Fifteen and 11 patients had surgery after failed placebo and exercise treatment, respectively, and were classified as failures of the allocated treatment. Their improvement after surgery was comparable to those randomized to surgery. This result suggests that surgery is preferable in some patients.

Therefore a crucial question is how or when these patients should be selected. Although the natural course

Table VII Prognostic factors

Variable	No. of patients	No. of failures	Multivariate adjusted* associations: Odds ratio for success (95% confidence interval)
Professional education			
>3 years	17	4	
<3 years	40	16	
Work with hand above level of head			
Sometimes/rarely/never	27	7	
Very often/often	27	13	
On sick leave			
No	21	2†	5.6 (1.2 - 29.2)‡
Yes	36	18	
Emotional distress			
No	37	13	
Yes	20	7	
Pain medication			
Not regular	32	6†	4.6 (1.2 - 15.8)‡
Regular	25	14	
Isometric endurance			
>120 sec	24	6	
<120 sec	33	14	
Neer test			
Complete pain relief	26	10	
Pain relief	28	9	

All patients who had surgery are included.
*Adjusted for age, sex, duration, and pain on activity at baseline.
†$P < .01$.
‡$P < .05$.

of symptoms in patients with rotator tendinosis is not known, results in this study suggest that spontaneous recovery occurs, because 25% of the patients given placebo had satisfactory results at follow-up. The median duration in these patients was 6 to 12 months, which was significantly shorter than those who had later surgery. Furthermore injection therapy is commonly used, although the documentation is scarce.[19,39,40] All of the patients included in this study had at least 1 cortisone injection before randomization. A variety of physiotherapy methods have been applied in patients with tendinitis of the shoulder. Commonly used physiotherapy techniques such as ultrasonography and soft laser probably act through a placebo mechanism.[11,26] Patients in this study reported little or no benefit from at least 12 sessions of physiotherapy given before inclusion. However, the difference between exercise therapy and placebo observed in this study indicates that patients with chronic subacromial pain should be advised to have a supervised exercise regimen, although its effect has not been compared with other physiotherapy methods. Judging from results in this study, patients with chronic subacromial pain who do not improve during 6 months on a supervised exercise regimen should be evaluated for surgery.

Prognostic factors. Previously poor results have been described in patients on sick leave.[29,33] The results in this study indicate that prolonged regular pain medication and sick leave are poor strategies in patients who have chronic subacromial pain. Patients who did not have a job for whatever reason had excellent results. Both work dissatisfaction and physical work demands may have contributed to the observed difference between patients on sick leave and those who did not have a job. A recent study reported 91% success in return to work in young patients who had physically demanding work.[14] The authors emphasized preoperative planning for return to work, explaining to patients that the surgery was a relatively minor procedure from which full recovery could be expected and that rehabilitation would be started immediately after surgery.

Psychologic factors have been accused for failed surgery, but results of this study, which included patients with a positive impingement test, do not support this view. A possible explanation is that emotional distress is normalized in conjunction with pain relief, or, alternatively, that a relatively well-defined shoulder disorder may be effectively treated in patients with concurrent emotional distress.

Mechanism. The supervised exercise regimen used in this study did not focus on pain but rather emphasized correction of muscular dysfunction, progressive muscular conditioning, and simple ergonomic advice. Correction of muscular dysfunction and strengthening

of the short rotators[17] may contribute to enlargement of the subacromial space.[36,42] Compared with muscle, tendons have poorer nutrition and a slower turnover.[37,41] The long rehabilitation period observed in both actively treated groups in our study may be attributed to an effect on slowly adapting collagen tissue, although the link between pain and tendon degeneration is uncertain.[27]

Motivational factors may explain why some patients do not improve, because exercises should be done at home in addition to sessions supervised by the physiotherapist.

Acromion morphologic characteristics were not evaluated in this study. Thus we cannot exclude the possibility that acromion morphology may have contributed to better results after later surgery in patients who did not improve from exercises. Pain inhibition through resection of the subacromial bursa is another probable explanation, but the mechanism for pain relief is still controversial, because good results are reported after resection of only the coracoacromial ligament.[1] We are not aware of prospective studies comparing the different methods.

CONCLUSION

We conclude that after $2^1/_2$-years of follow-up, both arthroscopic surgery and supervised exercises are better treatments than placebo. The difference between the 2 active treatments was not significant. Patients who do not improve on a supervised exercise regimen should be considered for surgery, but the prognosis is poor in patients receiving regular pain medication or on sick leave.

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