Research Report

Effects of Acupuncture Versus Ultrasound in Patients With Impingement Syndrome: Randomized Clinical Trial

Background and Purpose. There is no definitive evidence for the efficacy of the physical therapy interventions used for patients with impingement syndrome. The purpose of this study was to compare manual acupuncture and continuous ultrasound, both applied in addition to home exercises, for patients diagnosed with impingement syndrome. Subjects and Methods. Eighty-five patients with clinical signs of impingement syndrome were randomly assigned to either a group that received acupuncture (n=44) or a group that received ultrasound (n=41). Both interventions were given by physical therapists twice a week for 5 weeks in addition to a home exercise program. Scores from 3 shoulder disability measures, combined in the analysis, measured change during a period of 12 months. Results. Both groups improved, but the acupuncture group had a larger improvement in the combined score. Discussion and Conclusion. The results suggest that acupuncture is more efficacious than ultrasound when applied in addition to home exercises. [Johansson KM, Adolfsson LE, Foldevi MOM. Effects of acupuncture versus ultrasound in patients with impingement syndrome: randomized clinical trial. *Phys Ther.* 2005;85:490–501.]

Key Words: *Family practice, Home exercise program, Physical therapy, Rotator cuff, Subacromial pain.*

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Impingement syndrome is one of the most common diagnoses of patients with shoulder problems. A prevalence of 7% has been reported in a Swedish population.[1] In Dutch general practice, about 48% of patients who consulted a general practitioner for shoulder problems were diagnosed with impingement syndrome,[2] and this condition is reported to be persistent.[3]

In the current study, the term "impingement syndrome" is used. Patients with this syndrome experience pain in the deltoid muscle area, especially during arm elevation. Different maneuvers compressing the subacromial bursa and the supraspinatus muscle between the acromion and the humeral head can be used to reproduce this pain.[4,5]

Controversy exists about the pain-generating mechanisms in patients with impingement syndrome. In theory, pain from the subacromial structures can occur from extrinsic mechanical wear or compression from the coracoacromial arch, but there also may be intrinsic causes such as degenerative changes in the rotator cuff.[6]

These patients often receive different kinds of physical therapy interventions,[7] but there is no definitive evidence that physical therapy interventions are efficacious for patients with impingement syndrome.[8,9] The interventions chosen in our study—acupuncture, ultrasound, and home exercises—are commonly used interventions among physical therapists in Swedish primary care.[7,10] Acupuncture has been used by physical therapists in Sweden since the mid-1980s,[11] a more recent treatment alternative than ultrasound. Before the start of this study in 1997, two reviews had expressed doubt about the efficacy of therapeutic ultrasound for musculoskeletal disorders.[12,13] The most common strategy of physical therapists is to use a combination of interventions. Furthermore, there is a strong need for studies on existing physical therapy interventions.[14] Because both acupuncture and ultrasound are common interventions, often used in combination with exercises, and have a similar treatment setup, it seemed reasonable to compare them in this clinical trial.

The purpose of our study was to evaluate and compare the efficacy of 2 physical therapy strategies for patients with impingement syndrome: (1) acupuncture applied in addition to home exercises and (2) continuous ultrasound therapy applied in addition to home exercises. Using previously published instruments, the outcomes were measured during a period of 12 months.

Method

A prospective, observer-blind, randomized clinical trial was conducted.

Subjects

The subjects were recruited from 3 urban primary health care centers in the county of Östergötland, Sweden, from March 1997 to June 2000. Patients with shoulder pain who contacted the general practitioners or physical therapists at these primary health care centers were offered an encounter with the research physical therapist (KJ) if they were between 30 and 65 years of age. The general practitioners and physical therapists were instructed to recruit patients with clinical signs of a probable impingement syndrome, described as pain during abduction and pain located in the proximal lateral aspect of the upper arm.

Potential participants underwent a standardized clinical examination performed by the research physical therapist. At the inclusion visit, background data on age, sex, duration, occupation related to arm load, leisure activi-

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All authors provided concept/idea/research design, writing, and project management. Dr Johansson provided data collection, and Dr Johansson and Dr Foldevi provided data analysis and fund procurement. Dr Adolfsson and Dr Foldevi provided subjects. The authors acknowledge statisticians John Carstensen, Mats Fredrikson, and Olle Eriksson for statistical consultation. Mr Jan Brandinger, Ms Karin Lindgren, Mr Christer Nilsson, and Mrs Gunilla Stålmarck are acknowledged for their work as physical therapists throughout the study. The authors also thank all participating patients and staff at the involved primary health care centers.

This study was approved by the Ethics Committee of the Faculty of Health Sciences at Linköpings Universitet.

This study was supported by funding and facilities provided by the County Council of Östergötland and Linköpings Universitet, Sweden.

This article was received February 5, 2004, and was accepted November 19, 2004.

ties, smoking, and medical history were documented. The history included description of symptoms and pain location, duration of current episode, circumstances at onset of pain, pain related to rest, night sleep and activities, recurrence or a first-time problem, medication, and sick leave. The complete set of inclusion and exclusion criteria is shown in Figure 1.

Patients who were diagnosed as having probable impingement syndrome had a final inclusion test, an impingement test as described by Neer and Welsh.[5] The procedure was first to perform the Neer impingement sign test[5] and the Hawkins-Kennedy impingement sign test.[4] Then the impingement test, where a local anesthetic, 10 mL of prilocaine (10 mg/mL), was injected by a general practitioner with the patient seated, using a posterolateral injection approach with the needle entering the subacromial space.[15] If the patient reported relief of pain when the impingement sign tests were repeated 10 minutes after the injection, the test was judged as positive. If not, the maneuvers were repeated after another 20 minutes. If none of the exclusion criteria (Fig. 1) were present, the patient was asked to give informed consent to participate in the study. All patients signed informed consent statements at the end of the inclusion visit.

Of the 173 patients who visited the research physical therapist, 88 were diagnosed as having impingement syndrome and fulfilled the other inclusion criteria. Three of these patients did not enter the study, one due to working conditions, one because of a fear of needles, and one because of a myocardial infarction that occurred between the inclusion visit and the start of interventions. The affected shoulder of the remaining 85 patients was radiologically examined to exclude malignancy, osteoarthritis of the glenohumeral joint, and skeletal abnormalities. Standard anteroposterior and lateral projections were taken as well as a special projection of the acromioclavicular joint. None of the patients were excluded on the basis of the radiographs. Accordingly, 85 patients entered the study and were randomly assigned to either a group that received acupuncture combined with home exercises (n=44) or a group that received continuous ultrasound combined with home exercises (n=41).

Concealed randomization, based on a random list, with the treatment alternative in envelopes was carried out beforehand. The intervention was then introduced and performed by 4 physical therapists at the same primary health care center. All of the physical therapists were experienced and had worked in primary care for at least 12 years. In Sweden, acupuncture was approved in 1984 by the Swedish National Board of Health and Welfare to

Compulsory inclusion criteria:

- 30–65 years of age
- Typical history: pain located in the proximal lateral aspect of the upper arm (C5 dermatome), especially during arm elevation
- A positive Neer impingement test (subacromial injection of anesthetic)
- At least 2 months' duration of the current episode

Three of the following 4 inclusion criteria must be positive:

- Hawkins-Kennedy impingement sign
- Jobe supraspinatus muscle test (in 90° of abduction in the scapular plane)
- Neer impingement sign
- Painful arc between 60° and 120° of active abduction

Exclusion criteria:

- Radiological findings: malignancy, osteoarthritis of the glenohumeral joint, skeletal abnormalities decreasing the subacromial space (bony spurs, osteophytes)
- Known or suspected polyarthritis, rheumatoid arthritis, or diagnosed fibromyalgia
- Previous fractures of any bone in the shoulder complex or shoulder surgery on the affected side
- Dislocation of the glenohumeral joint or the clavicular joints on the affected side
- History or current clinical findings of instability in any joint of the shoulder complex (negative apprehension sign–relocation test for exclusion of ventral instability of the glenohumeral joint)
- Suspicion of frozen shoulder: time-dependent decreased range of movements following the capsular pattern (external rotation–abduction–internal rotation) and pain during intra-articular mobilization
- Problems from the cervical spine: shoulder symptoms reproduced with neck movements or a positive test for the foramina intervertebralia (pain or neurological symptoms during manual extension combined with manual lateral flexion and rotation toward the tested side)
- Having received any of the treatment alternatives in the study earlier for the current problem
- Having received a corticosteroid injection during the last 2 months for the current problem
- A clinical picture of ruptured rotator cuff (trauma, pronounced weakness, atrophy)
- Acute subacromial bursitis, making a clinical examination impossible due to pain
- Difficulty participating in data collection due to communication problem

Figure 1.
Inclusion and exclusion criteria.

be used by registered medical professions after additional training.[11]

Procedure

The acupuncture group received 10 treatment sessions. The physical therapists used standardized needle placement at 4 local points (LI 14 [Binao], LI 15 [Jianyu], LU 1 [Zhongfu], and TE 14 [Jianliao]) and one distal point (LI 4 [Hegu]) (Appendix 1). All points were chosen in accordance with current practice, and, before starting the study, all physical therapists were trained to locate these points. The depth and angle of needle insertion were those described in a Swedish manual.[16] The type of needle used was a HEGU* sterile and single-packaged one-time needle no. 8 (30 mm long and 0.30 mm in diameter). The treatment was repeated twice a week for 5 weeks, and each treatment session lasted 30 minutes. The patients lay on a treatment table on their unaffected side. After insertion into the defined points, the needle was rotated a few seconds until "de qi" was experienced by the patient. *De qi* is often described by patients as a sensation of heaviness, numbness, and radiating paresthesia.[11] It is believed to be a sign of the activation of the descending pain inhibitory systems, and opioid peptides are released, especially by the midbrain periaquaductal grey.[17,18] In total, 3 stimulations were performed (ie, at insertion and after 15 and 30 minutes). De qi was to be experienced at every stimulation at each acupuncture point, if not the needle was adjusted until this was the case.

The ultrasound group received continuous ultrasound twice a week for 5 weeks (10 treatment sessions). Each session lasted 10 minutes, and a standardized mode (frequency=1 MHz, spatial-average intensity=1 W/cm^2, gel coupling) was used. The size of the transducer was 4 cm^2, and the skin area treated was twice this size, covering an area of about 8 to 10 cm^2 inferior to the anterior and lateral part of the acromion. The transducer head was moved in small circles covering the area.[19] The patients were seated with the glenohumeral joint extended and medially rotated in order to make the muscle insertion of the supraspinatus muscle appear beneath and anterior to the acromion.[20] This joint position was maintained by placing the arm behind the back of the chair. The equipment used was a Phyaction 190† ultrasound device. The same equipment was used for all patients, and it was tested by an independent medical technician before starting the study and then once every 12 months. No recalibration was needed during the study.

Both interventions were combined with a 2-step home exercise program developed in and based on clinical practice as well as supported by research.[21] The chosen exercises in the first part of the exercise program were targeted to maintain or restore motion as well as to stimulate circulation in the rotator cuff using many repetitions of low-intensity exercises, without provoking pain from the involved tissues. In the second part of the exercise program, the target was to strengthen the rotator cuff muscles with the upper arm in a neutral position to avoid impingement. In all exercises, the position of a retracted shoulder was emphasized, in line with the findings of Solem-Bertoft et al,[22] where a protracted shoulder resulted in a narrowing of the anterior aspects of the subacromial space. Appendix 2 gives detailed descriptions of all of the exercises in the program.

At the first treatment visit, the patients received instructions from the physical therapist and practiced the exercises in part one of the program. They were instructed to perform the program daily for 5 weeks. After the first half of the treatment period, the patients received instruction and practiced the second part of the exercise program. All rotations were performed with a pillow in the axilla to decrease the activity in the deltoid muscle. The exercises were to be done every other day during the fourth and fifth weeks. Pain during the exercises was not to last more than 10 to 15 minutes after the program. If pain persisted longer than that, the patients were instructed to decrease either the resistance or the force produced. Adherence to the exercise program was monitored by a home exercise adherence log, and the use of additional medications was reported.

Outcome Measures

The research physical therapist, who performed the examinations and all assessments, was uninformed of treatment group assignments throughout the study. The same clinical examination (the Neer impingement test excluded), with the same assessment instruments, was repeated the week after the period of acupuncture or ultrasound was completed and 3, 6, and 12 months from the date of the initial visit. At each visit after the inclusion, current symptoms and differences from baseline were documented.

During the planning of the study in 1996, there was no consensus about which instrument should be used when assessing patients with impingement syndrome. This uncertainty and the decision of the European Society for Surgery of the Shoulder and Elbow[23] that the Constant-Murley Shoulder Assessment (CM Score)[24] should be used in all research involving patients with shoulder problems led to the choice of using 3 disease-specific shoulder assessment scales: the CM Score, the Adolfsson-Lysholm Shoulder Score (AL Score),[25] and the Univer-

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Table 1.
Outcome Measures[a] and Variables

Variable	Outcome Measure
Pain at rest	AL
Pain during activity	AL, CM
Ache, constant or intermittent, requiring painkillers or related to rest or activities	UCLA
Disturbed sleep due to pain	AL, CM
Active moments in the glenohumeral joint	
Abduction	CM
Flexion	CM, UCLA
Inward/outward rotation	CM
Level of activity	AL, CM, UCLA
Muscle force (glenohumeral joint):	
Abduction	CM
Flexion	UCLA
Instability (glenohumeral joint)	AL
Disability in leisure time/sports	AL, CM
Disability at work	AL, CM
Expectation of satisfaction with results (baseline)	UCLA
Satisfaction with results (at follow-ups)	UCLA

[a] AL=Adolfsson-Lysholm Shoulder Score, CM=Constant-Murley Shoulder Assessment, UCLA=University of California at Los Angeles End-Result Score.

sity of California at Los Angeles End-Result Score (UCLA Score).[26] All 3 scales were used at baseline and at each assessment visit. Their variables are described in more detail in Table 1.

The maximum score for the UCLA Score was 35 points; for the other 2 scales, the maximum score was 100 points. The AL Score is a pure patient self-assessment, and the other 2 scales also include clinical measures. For all instruments, the construct, content, and criterion validity and the knowledge about reliability, in our opinion, is insufficient. The CM Score and UCLA Score seemed appropriate based on our clinical experience, and both scales have been widely used.

The AL Score was chosen because it was developed for patients with impingement syndrome.[25] With respect to test-retest factors, we recently evaluated intraobserver reliability for the AL Score and found it to be stable over time for patients with impingement syndrome (unpublished data). Thirty-five patients with impingement syndrome of at least 2 months' duration completed the score twice. The interval was 3 to 7 days, and the score was repeated at the same time of the day. None of the patients received any intervention during the study, and, if they used medication for their symptoms, they were instructed to maintain the same level. The results were analyzed with a repeated-measures analysis of variance (ANOVA). The intraclass correlation coefficient for the total score was .91.

Data Analysis

All patients were adherent to the study protocol (no missed or additional interventions) during the 5 weeks of acupuncture or ultrasound. At the 3-, 6-, and 12-month visits, the number of patients who were adherent to the study protocol changed, as shown in Figure 2. In total, 64 patients were adherent to the study protocol throughout the study. The data were analyzed both for the group adhering to the study protocol and with an "intention-to-treat" (ITT) application model for analysis of data for clinical trials.[27] The latter analysis included all patients who were randomly assigned to groups. The principle of last observation carried forward (LOCF) was used in both analyses, using the scores recorded just prior to the missing scores in case of missing posttreatment values.[27] The number of patients where LOCF was used is illustrated in Figure 2.

A sample-size estimation resulted in a requirement of a minimum of 40 patients in each group, if the expected rate of improved patients was to be 30% better in one group than in the other group (β=.80, α=.05).[28] This level of difference was a compromise of what we judged to be a relevant clinical effect and an assumption of how many patients we expected to be possible to included in a 3-year period.

In the data analysis, we have chosen to combine the scores for the 3 outcome measures, using the mean of the 3 outcome measures' total scores. The maximum of 35 points for the UCLA Score and of 100 for the CM Score and the AL Score was corrected by multiplying the UCLA Score by 100 and then dividing by 35.

To compare background variables between the 2 treatment groups, we used a Student t test for continuous data, a chi-square test for categorical data, and a Mann-Whitney U test for ordinal data. A repeated-measures ANOVA was used to analyze the change in the combined shoulder disability score over time within the treatment groups. To compare the outcome between the groups, we used a general linear model analysis of covariance (ANCOVA) for repeated measures. The combined shoulder disability score at all 4 visits after the 5 weeks of acupuncture or ultrasound served as the dependent variable, and the starting score was the covariate. This analysis was chosen to adjust for the difference in baseline score between the groups. The level of statistical significance for all testing was $P<.05$.

Results

Before treatment, there were no differences in the background variables between treatment groups

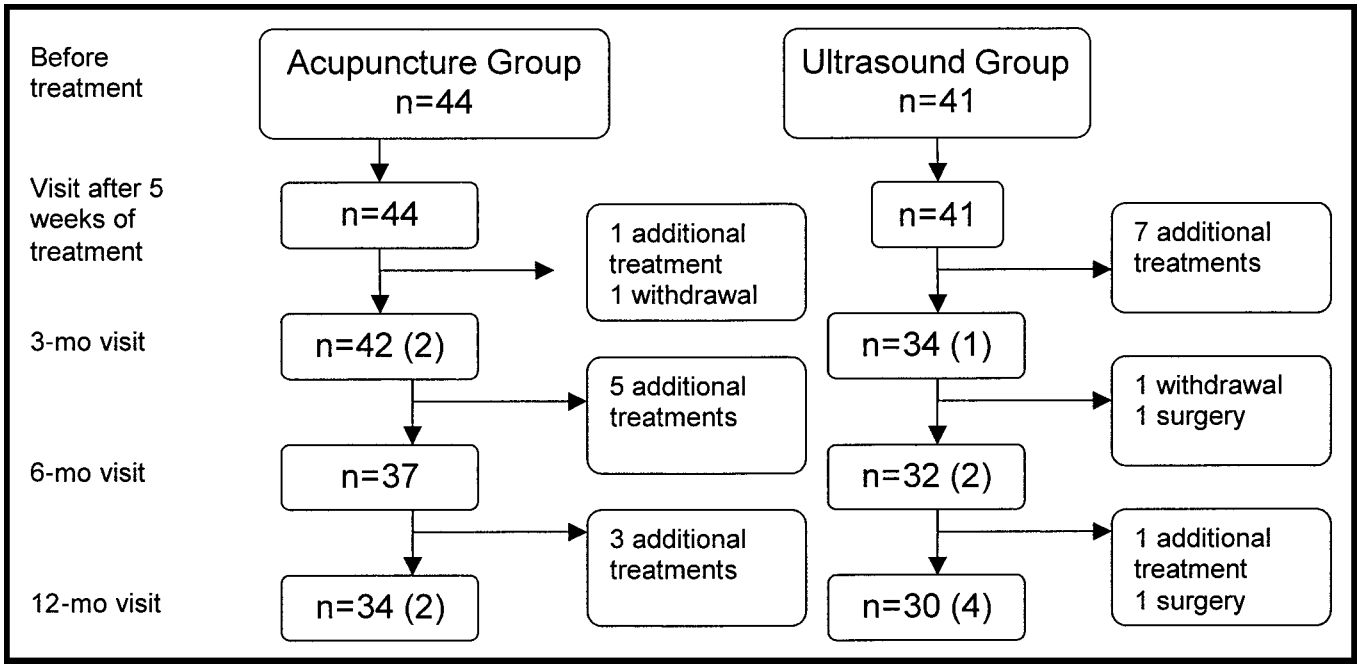

Figure 2.
Flow chart of the sample during the study (with the number where last observations carried forward has been used in parentheses).

Table 2.
Background Variables for the 2 Treatment Groups and Statistical Analysis Used

	Acupuncture Group (n=44)	Ultrasound Group (n=41)	Statistical Analysis
Sex: female/male (n)	32/12	27/14	NS,[a] Yates' corrected chi-square test
Age (y)			
$\bar{X}$	49	49	NS, Student *t* test
SD	7	8	
Duration of current episode (n)			
2–3 mo	13	11	NS, Mann-Whitney *U* test
4–6 mo	8	10	
7–12 mo	10	11	
>12 mo	13	9	
Occupation (n)			
Repetitive arm lifting, at least moderate load	18	17	NS, Fisher exact test
Static arm loading (ie, hair dresser)	4	3	
Computer work	16	15	
Similar to activities of daily living	4	4	
Retired	2	2	
Sick leave at start (n)	5	2	NS, Fisher exact test
Used painkillers during treatment or follow-up (n)	5	7	NS, Yates' corrected chi-square test
Exercise regularly or leisure activities loading the arm, at least once a week (n)	34	36	NS, Yates' corrected chi-square test
Smoking ≥10 cigarettes a day (n)	5	2	NS, Fisher exact test

[a] NS=nonsignificant (statistical level of significance: $P<.05$).

Table 3.
Outcome Measures for the Combined Score at Baseline and at Each Assessment Visit for Both the Group Adhering to the Study Protocol and the Intention-to-Treat Group (ITT) Using Last Observation Carried Forward for Missing Values

	Adhering to Study Protocol (n=64)				ITT (n=85)			
	Acupuncture		Ultrasound		Acupuncture		Ultrasound	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Baseline (before treatment)	61	7	63	6	61	7	63	6
After treatment	79	9	76	11	79	9	76	11
3-mo assessment	84	9	83	10	81	12	78	13
6-mo assessment	90	7	88	11	83	17	83	15
12-mo assessment	93	4	89	10	88	13	85	14

(Tab. 2). No adverse effects or side effects were reported in either group during or after the treatment period. Nine patients in the acupuncture group and 8 patients in the ultrasound group received additional treatment. These 17 patients were consequently not adhering to the study protocol, and their data were included in the ITT analyses.

Two patients underwent surgical subacromial decompression, and 2 patients withdrew from the study. One woman found the participation time-consuming and conflicting with her work, and one man declined further participation because he felt no improvement (Fig. 2). These 4 patients did not appear to differ in background characteristics or in scores in comparison with the other patients.

There were no differences in adherence to home exercises or in use of additional pain medication between the treatment groups. The number where LOCF was used was similar in both groups. The scores of the patients for whom LOCF was used did not appear to differ from the other patients.

Both treatment groups' mean scores at baseline and at each assessment visit are presented in Table 3. There were no differences between the treatment groups' mean scores at baseline. Both treatment groups improved during the study ($P<.0001$, ANOVA).

The between-group analysis, including the mean scores from all 4 assessment visits (after 5 weeks of acupuncture or ultrasound and at 3, 6, and 12 months), showed a larger change ($P=.045$, ANCOVA) in the combined score for the acupuncture group, analyzed with those adhering to the study protocol (Fig. 3). This effect was seen already at the first assessment visit and was maintained over time. In the ITT analyses, no differences were found across the 4 data collection periods.

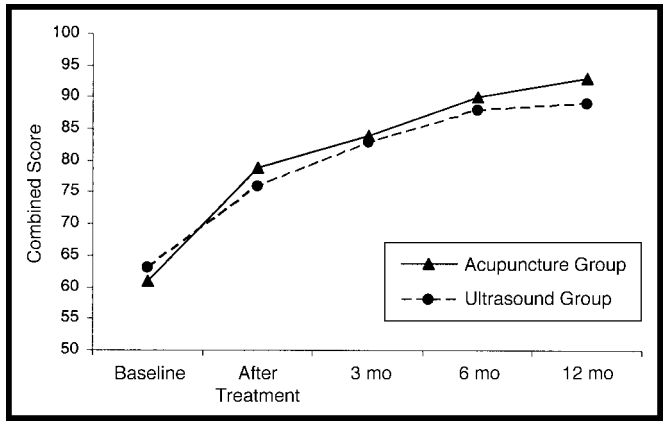

Figure 3.
Presentation of the mean in the combined score at each visit for the 2 treatment groups, including all patients who adhered to the study protocol (n=64). Between-group difference analyzed with analysis of covariance ($P=.045$).

Discussion and Conclusion

We set out to evaluate and compare 2 common treatment strategies in physical therapy for patients with impingement syndrome. The results showed that treatment with acupuncture in addition to home exercises was more efficacious than adding continuous ultrasound. This efficacy of acupuncture supports the earlier findings by Kleinhenz et al,[29] who compared acupuncture and a placebo needle and concluded that acupuncture was superior.

The magnitude of the treatment effect is unknown in the absence of a true control group. To our knowledge, no earlier study has dealt with the natural course of impingement syndrome. For unspecified shoulder pain, however, Ginn et al[30] reported no improvement after 1 month without treatment, and Macfarlane et al[31] described persistent disabling problems after 3 years.[30] The outcome illustrated in Figure 3 is probably a combination of a treatment effect and the natural course.

In our view, the patients selected for our study were representative of the general population seeking care for this type of shoulder problem. With a few exceptions, all referrals came from general practitioners and physical therapists in primary care, and this should avoid the risk

of studying a highly selective group (eg, patients from a sports or surgical clinic).

The analysis of the group adhering to the protocol in this study was used to evaluate the efficacy of the studied interventions, and the ITT analyses were used to examine the overall benefits of interventions in primary care. When interpreting the results, physical therapists should be aware that, although the patients included in this study had a more specific diagnosis than a group of patients with shoulder pain, there still could be other reasons than subacromial reasons for their pain and disability.

The maneuvers used for inclusion in our study have been reported to compress the structures of interest.[32] Some authors[33] have reported how the subacromial pressure increases during the impingement sign test. High sensitivity has been reported for Neer impingement sign test (75%–89%[34,35]) as well as for Hawkins-Kennedy impingement sign test (88%–92%[34,35]), but their specificity is lower (Neer impingement sign test: 31%–51%; Hawkins-Kennedy impingement sign test: 25%–44%[34,35]), which lessens their discriminative ability. The sensitivity for the Neer impingement sign test has been reported to be 70% to 83%.[36,37] This diagnostic injection test has been used in earlier research as the gold standard for identifying impingement syndrome.[34] In our study, it was used as a compulsory criterion, but in combination with other findings to increase its positive predictive value. In a recent review,[38] the inclusion criteria used in our study were reported as proper and the exclusion criteria as adequate because they control for conditions interfering with a successful outcome of treatment for patients with impingement syndrome. Despite a lack of certainty about what diagnostic tests should be used, we believe that the chosen combination of inclusion and exclusion criteria was sufficient for identifying a group of patients with impingement syndrome. Still, it is difficult to state whether or not there is a partial rupture of the rotator cuff, which could explain why some patients had less improvement than other patients.

Our choice to emphasize the importance of selecting interventions with similar setups as well as the use of a standardized treatment protocol is supported by the recent published CONSORT statement.[39] The conclusion in our earlier review that ultrasound is ineffective,[10] together with Kurtaiş Gürsel and colleagues' conclusion that ultrasound had no effect as additional treatment to physical therapy interventions,[40] may imply that this study compared home exercises with and without acupuncture.

The exercises used in our study were similar to those reported as efficacious in earlier studies.[41,42] The chosen exercise involving external rotation, with fixed elbows using a tube, has been reported to result in the highest activation of the infraspinatus muscle, a muscle that is important to strengthen in patients with impingement syndrome.[43] Ginn et al[30] reported that strengthening exercises and motor retraining were superior to no intervention for patients with shoulder pain. The repeated clinical examination at each assessment visit has a methodological advantage over follow-ups with scores mailed to the patients because bias from changing diagnoses over time can be avoided.[44]

Limitations of the Study

The major limitation concerns the instruments used for the outcome measure. Because all 3 measures have indeterminate measurement properties, we chose to use the mean of the 3 total scores, mainly to make the reporting of results less complicated than if all scores from all visits should be presented separately. This procedure decreased the variability and thus increased the power in the statistical analysis, but the sensitivity for change probably decreased, with a possible underestimation of the real effect. However, there is still an uncertainty about the instruments' qualities. The differences between the groups were small compared with the overall effect over time, but the differences that we found corresponded to 1 to 2 steps in the outcome scales (eg, 5 points corresponds to having or not having disturbing nightly pain that interferes with sleep, a difference we regard as clinically significant).

Another aspect when interpreting the results from this study is that the influence of psychosocial factors is unknown, because no instrument covering this area was used. To our knowledge, this is the first randomized clinical trial involving patients with impingement syndrome and comparing acupuncture and ultrasound, both combined with a home exercise program. The larger improvement in the acupuncture group, which was seen at the first assessment visit and maintained over time, indicates that a physical therapy strategy with a combination of acupuncture and home exercises is more beneficial for most patients with impingement syndrome. This conclusion is supported by our recent review,[10] where tentative evidence was found for the short-term efficacy of acupuncture and strengthening exercises. Furthermore, we concluded in that review that therapeutic ultrasound was ineffective in these patients.[10] In conclusion, acupuncture is advocated before ultrasound, in addition to home exercises, for patients with impingement syndrome.

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Appendix 1.
Description of Placement of the Acupuncture Needles

Acupuncture Point	Location	Depth	Angle
LI 4 Hegu	Between the first and second metacarpal bones. On the radial side, in level with the middle of the second metacarpal bone and at the highest point of the interosseus dorsalis muscle when the thumb is adducted.	0.5–0.8 cun[a]	90°
LI 14 Binao	Lateral side of the humerus, in front of the insertion of deltoid muscle (in line with LI 15)	0.5–0.7 cun	90°
LI 15 Jianyu	Distal to the anterior part of acromion, in the anterior hollow in the deltoid muscle, appearing during abduction of the glenohumeral joint	0.7–1 cun	45° distal, longitudinal to the humerus
LU 1 Zhongfu	Anterior of the processus coracoideus	0.3—0.5 cun	90° toward the palpable part of the processus coracoideus
TE 14 Jianliao	Distal to the posterior part of acromion, in the dorsal hollow in the deltoid muscle, appearing during abduction of the glenohumeral joint	0.7–1 cun	45° distal, longitudinal to the humerus

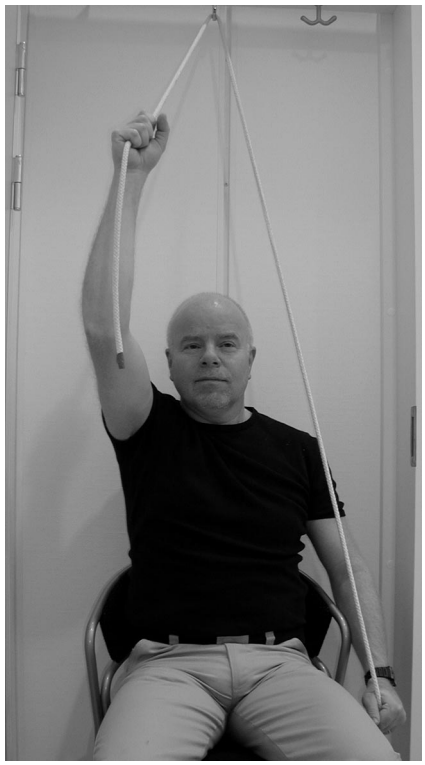
[a] 1 cun=the width of the patient's thumb.

Appendix 2.
Home Exercise Program

Home exercise program, part I:

Perform the program once a day between weeks 1 and 5.
Note each time in your home exercise adherence log.

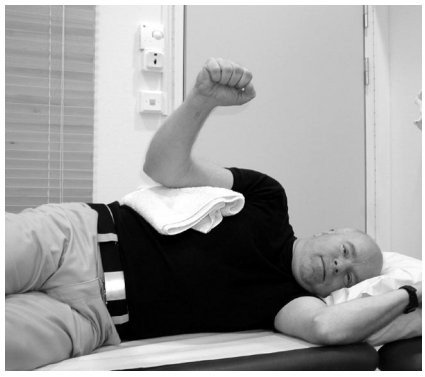
1. Seated under, for example, a hat rack, elevate the arms alternately by pulling in the sling (use a skipping rope or similar item).



20 repetitions

2. Lie on the side; rest your upper arm along the side of the trunk. Put a small pillow in the axilla and bend your elbow to about 90°, rotate externally and then lower it slowly.

30 repetitions



(continued)

Appendix 2.
Continued

Home exercise program, part II:

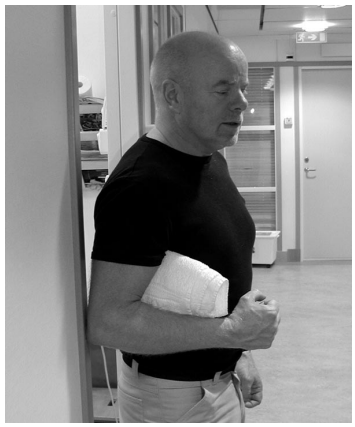
Perform the program once every other day between weeks 4 and 5.
Note each time in your home exercise adherence log.

Strengthening exercises:

3. Bend your elbow to 90°. Stand in a doorway and press your fist against doorpost in the following manner: use a pillow in the axilla, no movement shall occur.

10 repetitions in each direction

Foreward



Backward

Internal rotation

External rotation

To the side (abduction)

4. Standing with both elbows bent to 90°. External rotation of the shoulder, using a section of tubing as resistance, and then return slowly to starting position. Put pillows or towels in the axilla.

15 repetitions × 2

Pain during these exercises should not remain more than 10 to 15 minutes after the end of program. If a longer duration is experienced, decrease either the resistance or the force produced.