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ORIGINAL REPORT

RIGID SHOULDER TAPING WITH PHYSIOTHERAPY IN PATIENTS WITH SUBACROMIAL PAIN SYNDROME: A RANDOMIZED CONTROLLED TRIAL

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Objective: **To assess the effectiveness of individualized physiotherapy in combination with rigid taping compared with individualized physiotherapy alone in patients with subacromial pain syndrome.**

Design: **A prospective randomized trial with concealed allocation.**

Patients: **A total of 140 patients between 18 and 65 years of age from primary physiotherapy settings.**

Methods: **The intervention group received individualized physiotherapy and shoulder taping. The control group received individualized physiotherapy only. Primary outcomes were: pain intensity (numerical rating scale) and functioning (Simple Shoulder Test). Secondary outcomes were: global perceived effect and patient-specific complaints. Data were collected at baseline, and at 4, 12 and 26 weeks' follow-up.**

Results: **During the 6-month follow-up period multilevel analysis showed a significant difference between groups favouring the control group on pain intensity ($p = 0.02$), but not on functioning. Regarding secondary outcomes, a significant difference between groups was found favouring the intervention group for global perceived effect ($p = 0.02$), but not for patient-specific complaints.**

Conclusion: **Rigid shoulder taping, as used in this study, cannot be recommended for improving physiotherapy outcomes in people with subacromial pain syndrome.**

Key words: shoulder impingement syndrome; physical therapy modalities; randomized controlled trial; multilevel analysis; pain.

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Shoulder problems are a common complaint of the musculoskeletal system. The diagnostic label subacromial impingement syndrome is the most frequent diagnosis (1), accounting for 44–65% of all shoulder complaints (2, 3). This label covers a range of rotator cuff disorders as well as subacromial bursitis. Although the label is commonly used in research and clinical practice, there is little evidence for an acromial impingement model. Hence, researchers have suggested distinguishing mechanical impingement as a potential mechanism of rotator cuff and bursa pathologies from shoulder impingement syndrome as a clinical diagnostic label (4). Recently, Lewis (5) suggested changing the label subacromial impingement syndrome to subacromial pain syndrome (SAPS), reflecting the view that the syndrome is a result of intrinsic (e.g. ageing, genetics, vascular changes and altered loading), extrinsic (e.g. contact of the humeral head with the coracoacromial arch), or combined mechanisms (6). It is believed that the diagnostic label SAPS is more accurate because it does not presume a specific pathological mechanism. Lewis' suggestion has recently been adopted by Dutch physiotherapy shoulder networks (7) and the Dutch Orthopaedic Association (8) and is used in this paper.

Although SAPS might be a better diagnostic label, it does not provide a clear biological understanding of the problem and it is too broad to be very informative for the doctor, physiotherapist and patient. Uncertainty about treatment and prognosis of SAPS is reflected in the wide range of interventions for the condition, including surgery, injections, medication, physiotherapy and attention to lifestyle factors.

One of the interventions for SAPS that is frequently used by physiotherapists in addition to exercise programmes is taping (9, 10). The essential function of most taping techniques is to provide protection and support during active movements of the shoulder. It is also believed that taping has an effect on scapular muscle activity by improving proprioceptive feedback to the central nervous system (11). Several different taping techniques have been suggested for shoulder problems (9). In a recent review, 10 randomized controlled trials were identified that compared taping with another intervention or placebo for treatment of rotator cuff tendinopathy (9). Four trials evaluated non-elastic or rigid taping, and 6 elastic or kinesiology taping. Four trials evaluated the efficacy of taping alone and 6 assessed taping in conjunction with mobilization and/or exercises. Most randomized controlled trials had a high risk of bias, used small sample sizes (maximum 52 patients) and short follow-up periods (maximum 6 weeks). The authors of the review concluded that, although some of the included studies appear to show

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some clinical efficacy, there is insufficient evidence on the efficacy of taping. They suggest that more high-quality studies are needed with longer follow-up times and larger sample sizes.

The question for this randomized controlled trial was: what is the effect of adding rigid shoulder taping to physiotherapy for people with SAPS in the primary healthcare setting?

MATERIAL AND METHODS

The methods used are briefly described below, and more completely in the study protocol (12). The study was approved by the Medical Ethics Committee of the VU University Medical Centre in Amsterdam (registration number: 2010\119).

Design

At the first consultation, participating physiotherapists informed all eligible patients who attended their primary care clinic about the study and assessed them for the inclusion and exclusion criteria. Eligible patients were further instructed about the study through a patient's information letter. The physiotherapists provided contact details of interested patients to the principal investigator of this study (AA). This investigator telephoned the potentially eligible patient before the second consultation to answer questions and to provide additional information about the study. If the person decided to participate, informed consent was signed and baseline questionnaires were completed at the second consultation. Subsequently, the physiotherapist opened a sealed, numbered, opaque envelope containing the treatment allocation. Prior to the study, each practice was provided with 10–20 numbered envelopes. The content of the envelopes was determined with a computer-generated randomization list. To prevent unequal treatment-group sizes, patients were randomized according to a stratified block randomization method, in blocks of 4. The participating physiotherapists were blind to the sequence of the randomization method to guarantee allocation concealment.

Primary and secondary outcomes were assessed at 4 and 26 weeks after the start of treatment, by means of postal questionnaires. Owing to the nature of the interventions and the patient self-reported outcomes, blinding was not possible for patients. At 12 weeks, the principal investigator conducted telephone interviews to assess pain intensity (numerical rating scale; NRS) and global perceived effect. The principal investigator was not blinded to group assignment. The participating physiotherapists were not involved in the data collection or analysis.

Patients, therapists and centres

Patients were recruited by physiotherapists from 24 private physiotherapy clinics in the city of Amsterdam and the surrounding (rural) area (< 50 km radius). Inclusion criteria were: at least 2 positive tests indicating SAPS (the painful arc of abduction test, the empty can test (Jobe test), the external rotation resistance test, and the Hawkins-Kennedy test); age between 18 and 65 years; SAPS being the primary complaint; and accepting the conditions of participation in the study. Exclusion criteria were: structural narrowing of the subacromial space confirmed with radiography and/or diagnostic ultrasound (e.g. as a cause of scapulohumeral joint dysplasia, acromioclavicular arthropathy or a total cuff tear) (13); operated previously at the shoulder or cervical spine; rheumatic disease, such as polymyalgia rheumatica, rheumatoid arthritis, lupus erythematosus or fibromyalgia; severe arthritis of the glenohumeral joint; 3 or more subacromial corticosteroid injections in the last year; (suspected) severe disease, such as malignancy; severe trauma of the shoulder in the last 6 months; neurological disease with negative consequences for the shoulder, such as cerebral vascular accident, multiple sclerosis or Parkinson's disease; type II diabetes; luxation or fracture of the affected shoulder; cervico-radicular syndrome; pathology of organs with negative consequences for the shoulder; dementia; psychiatric disease; insufficient understanding of the Dutch language; bad condition of the skin around the affected shoulder because of a skin disease; or allergy to tape.

Participating physiotherapists treated patients assigned to both the intervention and control group. All had received training and instruction regarding the taping technique by the principal investigator prior to the study. This study has been registered in Dutch trial register (www.trialregister.nl) as NTR2575.

Intervention

All patients received individualized physiotherapy. During the first 4 weeks of treatment, the use of medication was allowed, but other co-interventions were discouraged. For patients allocated to individualized physiotherapy without rigid shoulder taping (control group), the use of elastic or kinesiology taping by the physiotherapist was allowed. Patients assigned to the intervention group received individualized physiotherapy and shoulder taping for at least 4 weeks. The taping technique was a modified version of Shamus & Shamus (14), and applied at the end of each treatment session. This tape method had shown good results in an observational study of 10 persons (age range 55–76 years) with a total cuff rupture diagnosed with magnetic resonance imaging (MRI) and long-lasting pain (duration range 4–72 months). After 5 weeks of only shoulder taping, 6 out of 10 patients were very satisfied with the treatment result, 1 quite satisfied, 1 a little satisfied, and 2 not satisfied (15).

Taping technique

Patients were taped whilst their affected arm was on the treatment table, with the shoulder in approximately 80° abduction in the plane of the scapula. Two strips of rigid tape (Leukotape®, BSN Medical, Almere, The Netherlands) were placed on 2 strips of elastic tape (Fixomull Stretch®, BSN Medical) without tension. Thus, when the arm was brought back to a relaxed position along the body, it was held slightly abducted from the body (approximately 10°) due to the tension of the tape (Fig. 1a and b). The tape was worn for a minimum of 2 days, and a maximum of 7 days. The tape was worn for short periods (2–3 days) for persons with severe pain and at the beginning of the tape period, and longer for persons with less pain who were familiar with wearing the tape. In order to produce less tension in persons with severe pain, patients with > 7 points on the NRS (0–10) were taped with the shoulder in less abduction (50–70°). This decision was taken on the basis of clinical experience that, in general, patients with severe pain cannot bear the high tension of the tape. The person was instructed to remove the tape at least 1–2 days before the next treatment, in order to let the skin recover. The physiotherapist determined the exact abduction angle of the shoulder in which the shoulder was taped, the number of days the tape was worn, and the number of treatments per week. The process of applying the tape took approximately 5 min. During the first 4 weeks, the tape treatment

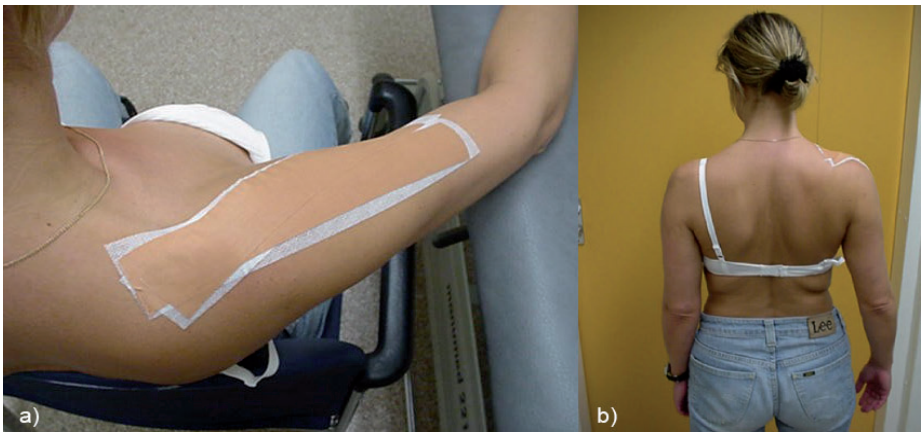

Fig. 1. Tape technique. (a) Tape is applied to the shoulder in 80° abduction and 30° forward flexion. (b) In a relaxed position, the arm hangs in slight abduction due to the tension of the tape.

was stopped if the person was free of pain, allergic to tape, or reported a substantial increase in complaints.

The working mechanisms of shoulder taping remain hypothetical and are likely to be multi-factorial. Possible mechanisms of the rigid shoulder taping, as used in this study, are correcting aberrant humeral and scapular positions (16, 17), correcting shoulder girdle kinematics caused by muscle imbalance (9, 17–19), stimulating joint mechanoreceptor activity, which, in turn, modulates pain via the gate control theory (11, 17), reducing myofascial trigger-points in the trapezius descendens by prolonged stretching of this muscle (17), reducing the wringing out of the microvascular bed of the supraspinatus in the critical zone because of the slightly abducted position of the arm (20), reduction in the use of the shoulder as the patient is more aware of the painful shoulder, giving a feeling of support (19) and a placebo effect (11).

Outcome measures

The baseline questionnaire included socio-demographic characteristics and primary and secondary outcome measures (Table I). Two primary outcomes were utilized: functioning, using the Simple Shoulder Test (SST, 100-point scale, 12 items) and pain intensity using a 11-point NRS. For the SST the possible scores vary from 0 (no disability) to 100 (maximum disability) and for the NRS from 0 (no pain) to 10 (maximum pain). Global perceived effect and patient-specific complaints were secondary outcome measures. Global perceived effect was measured by self-assessment on a 7-point Likert scale, ranging from completely recovered to worse than ever. This was dichotomized a priori into success (1–2: completely recovered and much recovered) and non-success (3–7: slightly recovered to worse than ever). The possible scores for patient-specific complaints vary from 0 (no problems) to 10 (maximum problems). Information regarding treatment programmes, treatment goals, number of treatment sessions, tape adhesion and the presence or absence of tape irritation was also recorded.

Data analysis

Sample size calculations were performed for the 2 main outcome measures (power 0.95; alpha 0.05), based on the studies of Santamato et al. (21) and Tashjian et al. (22). To detect a clinically relevant mean difference between the 2 treatment groups of 2 points on the SST (2-point scale, standard deviation (SD) 2) (22), sample size calculations indicated that 26 patients would be required per group. To detect a clinically relevant mean difference of 2 points (SD 3) for pain (11-point NRS) (21), sample size calculations indicated that 59 patients would be required per group. Anticipating potential drop-out of 15%, the sample size was determined to be 70 patients per treatment group (total $n = 140$).

Descriptive statistics and frequency distributions of all baseline variables were assessed. Differences in baseline characteristics between the 2 groups were analysed to detect any differences in potential prognostic factors that needed to be included as covariates.

All outcome data were analysed according to the intention to treat principle. All continuous responses were analysed via linear mixed models, with responses at 0 (baseline), 4, 12 and 26

Table I. Baseline characteristics of patients

Characteristics	Exp group ($n = 72$)	Controls ($n = 68$)
Age, years, mean (SD)	48 (11)	50 (11)
Sex, *n* male (%)	36 (50)	27 (40)
Regard themselves as being Dutch, *n* (%)	70 (97)	63 (93)
Side of shoulder affected, *n* right (%)	45 (63)	42 (62)
Arm affected, *n* dominant (%)	49 (68)	42 (62)
History of shoulder pain		
First shoulder pain in their live (months), median (IQR)	12.0 (4.0–48.0)	18.0 (4.5–96.0)
Previous episodes of shoulder pain, *n* (%)	29 (40)	34 (50)
Duration of current shoulder pain (months), median (IQR)	6.0 (2.0–16.3)	4.0 (1.9–12.0)
Acute (0–6 weeks), *n* (%)	14 (19)	16 (24)
Sub-acute (7–12 weeks), *n* (%)	8 (11)	6 (9)
Chronic (>12 weeks), *n* (%)	50 (69)	46 (68)
Injections (<3) in the affected shoulder last year, *n* (%)	4 (6)	8 (12)
Pain past week, numerical rating scale, (0–10), mean (SD)	6.2 (1.9)	6.6 (1.8)
Simple Shoulder Test (0–100), mean (SD)	45.5 (25.1)	56.3 (23.7)
Patient-specific complaints (0–10), mean (SD)	6.4 (2.2)	6.9 (2.1)
Currently taking pain medication, *n* (%)	31 (43)	25 (37)
Marital status, *n* (%)		
With a partner	48 (67)	52 (76)
Single	24 (33)	16 (24)
Educational level, *n* (%)		
Low	17 (24)	15 (22)
Middle	44 (61)	40 (59)
High	11 (15)	13 (19)
Employed, *n* (%)	56 (78)	53 (78)
Employed and currently working	49 (88)	49 (92)
Employed, but currently on sick leave	7 (13)	4 (8)
Short-Form 36, mean (SD)		
Physical Component Summary (0–100)	43.9 (7.8)	39.8 (7.0)
Mental Component Summary (0–100)	51.0 (10.9)	51.7 (10.0)

Exp group: experimental group; SD: standard deviation; IQR: interquartile range.

weeks. In multilevel analyses physiotherapists clustered under practices, patients under physiotherapists, and repeated measurement clustered within a patient. Baseline scores were taken into account and the effect of interest for the present study was the time by treatment interaction. Regression coefficients with 95% confidence intervals (95% CI) between baseline and follow-up measurements were calculated. In addition, analyses were adjusted for the possible confounding influence of sex and age and, if appropriate, for patients' or physiotherapists' characteristics that differed between the 2 groups. The appropriate covariance structure was selected using Akaike's information criterion.

For the dichotomous outcomes a generalized linear mixed model (logit link) was used with the same multilevel structure, and the effect of interest was the difference between groups at each time point. Odds ratios (OR) with 95% CI between the intervention and the control group were calculated. No multiple imputations were performed for missing data, as it has been shown that this is not necessary when performing a mixed-model analysis on longitudinal data (23).

As sensitivity analysis, a per-protocol analysis was performed for all outcome measures to estimate the extent to which protocol deviations might have influenced the results. A deviation from the protocol was defined as not receiving treatment after allocation, withdrawal from therapy after 1–3 visits (but not because of sufficient results of treatment), and not being treated according to treatment allocation. For all tests $p < 0.05$ (2-tailed) was considered significant.

RESULTS

From September 2010 to December 2011, 168 persons were evaluated for eligibility. As described in the flow chart (Fig. 2), 28 persons did not meet the inclusion criteria. This resulted in a sample of 140 patients (intervention group $n=72$; control group $n=68$). Of these patients, 56% were women, the mean age was 48.8 (SD 11.1) years, 44.4% had previous episodes of shoulder complaints, and 69% had chronic (>12 weeks) shoulder complaints. Baseline characteristics of patients in each group are presented in Table I. At baseline, scores on the SST and the subscale Physical Component Summary (PCS) of the Short-Form 36 were statistically significant worse in the control group.

At follow-up, complete clinical outcome data (data on all 4 outcome measures) were not available for 16 patients (11%) at 4 weeks, and were not available for 14 patients (10%) at 26 weeks. The 12-week telephone interview was not completed by 6 patients (4%). Baseline characteristics differed between the patients assessed at 26 weeks ($n=126$) and for patients without complete clinical outcome data ($n=14$) for; SST (median 50.0 (interquartile range (IQR) 33.3–66.7) vs median 66.7 (IQR 54.2–83.3), respectively), PCS (mean 42.3 (SD 7.6) vs mean 37.8 (SD 6.7), respectively) and for regarding themselves as being Dutch (96.7% vs 75.0%, respectively).

Patients were included with 2 out of 4 (38.1%), 3 out of 4 (42.5%) or 4 out 4 (19.4%) positive shoulder tests. Additional information from radiography and/or diagnostic ultrasound was available for 13 patients (9.3%). Patients in the intervention group received fewer treatment sessions than the control group, median 12.0 (IQR 8.0–19.5) vs 14.0 (IQR 9.3–23.5), respectively; however, the difference was not significantly different ($p=0.08$). Patients were treated in 25 private physiotherapy practices by 48 physiotherapists, of whom 67.9% were also manual therapists. Compared with the control group, patients in the intervention group were more frequently treated by manual therapists (72.2% and 63.2%, respectively), but this difference was not significant ($p=0.28$). Treatment programmes consisted of mainly active interventions (treating impairments 95%, training activities 55%, coaching 69%, mobilization/manipulation 67%, massage 34% and electrotherapy 7%) and were comparable between the 2 groups. A total of 14 patients (20.6%) in the control group were treated with elastic or kinesiology taping (median 7.0 days, interquartile range (IQR) 5.0; 20.5) during the first 4 weeks). The treatment goals were also similar for both groups (diminishing pain 84%,

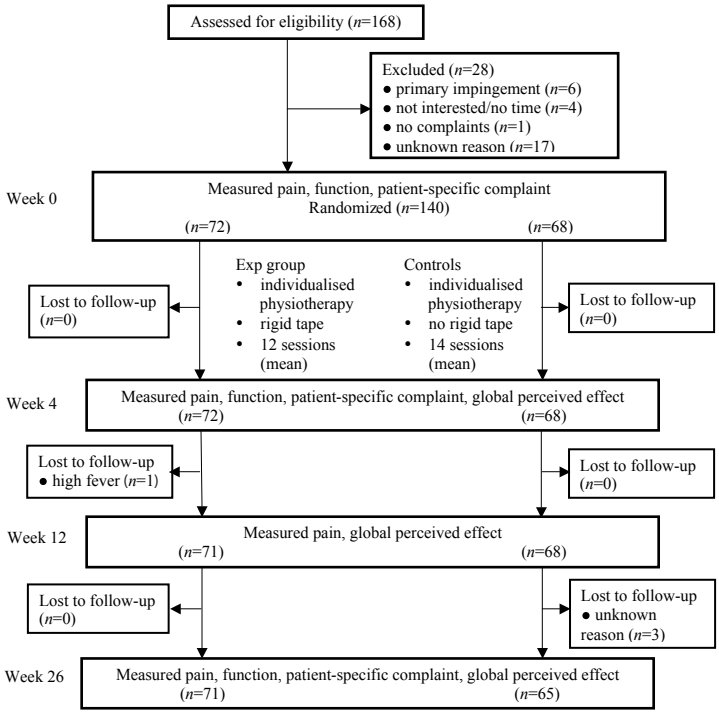

Fig. 2. Design and flow of patients through the trial. Exp group: experimental group.

restoring function 87%, restoring activities 64%, restoring participation 32%, influencing external factors 5% and personal factors 14%). Patients in the intervention group were taped with rigid tape for a mean of 18.0 days (SD 7.5) during the first 4 weeks. In this group, mild and severe skin problems were recorded for 34.4% and 14.0% of the cases, respectively. In one case (3.7%) the adhesion of the rigid tape was insufficient.

Effect of treatment

Multilevel analysis showed a significant difference between groups favouring the control group on pain intensity ($p=0.02$), but not on functioning over the course of the 6-month follow-up period. With regard to specific time-points, there was a larger reduction in pain intensity at 4 weeks in the control group (adjusted mean difference, 0.97; 95% CI: –1.80 to –0.13, $p=0.02$), but no difference at 12 and 26 weeks. On secondary outcomes, a significant difference between groups was found favouring the intervention group on global perceived effect ($p=0.02$), but not on patient-specific complaints during the 6-month follow-up period. Better success rates were found at 12 weeks (adjusted OR 6.02; 95% CI 1.74–20.68, $p<0.01$) but not at 12 and 26 weeks. At 4, 12 and 26 weeks the success rates (global perceived effect; completely recovered and much recovered) for the intervention group were 34.9%, 72.5% and 71.8%, respectively, and for the control group 34.9%, 47.7% and 58.7%, respectively (Table II). Table II shows regression coefficients and estimates of the mean scores at the respective time-point, as predicted by the regression model. It is worth noting that these estimates are very close to what can be calculated from the crude means.

In addition, the potential confounders age, sex and SST at baseline were simultaneously included in the intention to treat analyses. SST at baseline was included as a covariate in the models for pain and secondary outcome, because the difference between groups at baseline was 10.8%. Although this was less than the minimal important change (24), SST was considered a potential confounder in the present study. The statistical models contained both fixed (treatment, time, treatment-by-time interaction, age, sex and SST at baseline) and random effects (patient, physiotherapist and practice). Adjustment for potential confounding variables did not appreciably change the results (data not shown).

Per-protocol analysis

In the per-protocol analysis 135 patients were evaluated (intervention group $n=70$, control group $n=65$). Reasons for excluding the 5 patients were: (*i*) withdrew from therapy after 1–3 visits, but not because of recovery (1 patient was not insured, 1 patient wanted an injection instead of physiotherapy); (*ii*) not treated according to patient's treatment allocation (3 patients in the control group received rigid tape). The characteristics at baseline did not differ between the patients included in the per-protocol analysis and those excluded. The per-protocol analyses found similar results to the intention-to treat (data not shown).

Table II. Mean (95% confidence interval; 95% CI) or percentage outcomes of the groups and regression coefficients (95% CI) or odds ratio (95% CI) for the differences between groups for primary and secondary outcomes at 4, 12 and 26 weeks for the 140 patients. Values presented are model estimates from linear mixed-effects models with a random intercept and adjusted for baseline. Regression coefficients can be interpreted as mean differences between interventions at a certain follow-up moment compared with baseline; positive values favour the experimental group

Outcome	Exp group ($n=72$)	Controls ($n=68$)	Overall effect* and adjusted between-group difference (regression coefficient)
Primary			
Numerical rating scale (0–10)			$F_{3,133}=3.35$ ($p=0.02$)
Baseline	6.2 (5.7 to 6.7)	6.6 (6.1 to 7.1)	
4 weeks	4.9 (4.3 to 5.4)	4.3 (3.7 to 4.9)	–0.97 (–1.80 to –0.13)
12 weeks	2.7 (2.1 to 3.3)	3.4 (2.8 to 4.0)	0.26 (–0.61 to 1.13)
26 weeks	2.9 (2.3 to 3.5)	3.2 (2.5 to 3.8)	–0.16 (–1.12 to 0.81)
Simple Shoulder Test (0–100)			$F_{2,125}=1.81$ ($p=0.17$)
Baseline	45.8 (39.4 to 52.2)	57.0 (50.6 to 63.5)	
4 weeks	29.9 (23.6 to 36.1)	35.9 (29.7 to 42.1)	–5.17 (–13.77 to 3.43)
26 weeks	15.6 (9.2 to 21.9)	28.9 (22.3 to 35.4)	2.09 (–7.74 to 11.92)
Secondary			
Patient-specific complaints (0–10)			$F_{2,204}=0.76$ ($p=0.47$)
Baseline	6.4 (5.8 to 6.9)	6.9 (6.3 to 7.5)	
4 weeks	4.7 (4.1 to 5.4)	4.7 (4.1 to 5.3)	–0.54 (–1.50 to 0.41)
26 weeks	2.7 (2.0 to 3.4)	3.2 (2.6 to 3.9)	0.01 (–0.98 to 1.00)
Global perceived effect			Wald = 9.74, df = 3 ($p=0.02$) (odds ratio)
4 weeks, %	34.9	34.9	0.92 (0.28 to 3.08)
12 weeks, %	72.5	47.7	6.02 (1.74 to 20.68)
26 weeks, %	71.8	58.7	2.64 (0.79 to 8.84)

*F-statistics refer to the test of treatment-by-time interactions. Exp: experimental group.

For all analyses and outcome measures, the intraclass correlation coefficients within physiotherapy practices and within physiotherapists varied between 0 and 0.05, indicating no practice- or therapist-specific effect.

DISCUSSION

The objective of our study was to assess the effectiveness of individualized physiotherapy in combination with rigid taping for SAPS compared with individualized physiotherapy alone. The results were mixed. The intervention group scored worse than the control group on pain, but better on global perceived effect, over the course of the 6-month follow-up period. No differences between groups were found on functioning and patient-specific complaints during the 6-month follow-up period. In general, we must conclude that the analyses showed no differences on primary and secondary outcomes in favour of either treatment protocol. Our results are in line with a recent review about the effects of elastic and rigid shoulder taping in persons with rotator cuff tendinopathy, which did not find that taping reduced pain or improved function (9).

The present study found significant mean differences between the 2 groups at only 2 specific follow-up time-points. The differences were on different outcome measures, and 1 showed better outcome in the intervention group, and the other in the control group. The intervention group scored worse on pain intensity than the control group after 4 weeks, but better on global perceived effect after 12 weeks. In order to understand these results, a closer look at the results and trial's methodological limitations is important. After 4 weeks differences among groups on pain were statistically significant different; however, they were small (–0.97; 95% CI: –1.80 to –0.13) and not considered clinically important (25). Concerning the results from global perceived effect, it is known that the meaning of the concept recovery is complex (26). For example, Carroll et al. (27) showed in a qualitative study that patients show a considerable variability in the meaning of recovery. Another possibility to explain the better results on global perceived effect in the intervention group after 12 weeks relates to patient's expectations and beliefs about treatment. Interestingly, expectations to recover are associated with actual recovery, and it has been argued that expectations might be more important than the intervention itself (28). Because patients could not be blinded to the treatment, it might be that the patients in our intervention group expected a larger effect from the tape intervention and were more positive on global perceived effect compared with the control group who may have been disappointed not to receive tape. However, this does not explain why the difference was observed at one follow-up point and not the others. A feature that could account for the positive results on global perceived effect in the intervention group relates to the assessment method at 12 weeks. At baseline and 4 and 26 weeks follow-up, data were collected by digital or paper questionnaires; however, data were collected at 12 weeks by telephone interviews. These were conducted by the principal investigator who was not blind to the patient's group assignment. Although the investigator tried to be as neutral as possible, patients in the intervention group might have produced positive global perceived effect results in an attempt to please the investigator.

If benefit of taping occurs in a specific subgroup of persons with SAPS these benefits need to be considered against the risk of adverse skin reaction. In our patients, mild and severe skin problems were recorded for 34.4% and 14.0% of the cases, respectively. Also, if a subgroup benefits from the taping technique used in the present study another subgroup will worsen. It seems as important to identify this subgroup to avoid unnecessary treatment.

Patients in the intervention group received fewer treatment sessions than the control group, although the difference was of borderline statistical significance. Possible explanations for this difference might be related to the intervention or the slightly better physical status of the intervention group on the SST and the Short-Form 36, Physical Component Summary subscale.

Strengths of this randomized controlled trial are that the protocol was published prospectively and we conducted the trial according to this protocol, the patients sample represented the target population, and sufficient patients were recruited and followed to meet the sample size and power requirements of the study.

This study also has some limitations. Apart from the non-blinded telephone interviews at 12 weeks by the principal investigator, baseline differences on physical functioning were found between the 2 treatment groups. Although these differences were adjusted for in the statistical analyses, it cannot be ruled out that they might have influenced the results. Another limitation is that no protocol was used for the treatment. However, this should not have had a major effect on the results, because treatment programmes and goals were similar for both groups. The present study used broad inclusion criteria and one specific taping technique. It might be that a sub-group of responders exists or other tape techniques produce better results. The results of this study do not inform which subgroup of persons, if any, might benefit from taping or which tape techniques produce the best results. Further research investigating the efficacy of various tape techniques should focus on more homogeneous subsets of persons,

using a valid and practical classification system (29). A final concern is that it cannot be ruled out that some patients with structural narrowing of the subacromial space participated in this study. Information from radiography and/or diagnostic ultrasound was available only for a minority of patients (9.3%).

In conclusion, the tape technique used in this study did not bring additional value in a population of persons with SAPS treated by individualized physiotherapy and cannot be recommended for use in clinical practice.

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