Original Research

Kinesiology taping with exercise does not provide additional improvement in round shoulder subjects with impingement syndrome: A single-blinded randomized controlled trial

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ABSTRACT

Objective: Round shoulder posture (RSP) may exaggerate symptoms of subacromial impingement. The effects of kinesiology taping with exercise on posture, pain, and functional performance were investigated in subjects with impingement and RSP.
Design: This study was a single-blinded randomized controlled trial.
Setting: An outpatient rehabilitation clinic in a university hospital.
Participants: Thirty-four subjects with subacromial impingement and RSP.
Interventions: Kinesiology taping with and without tension was applied 2 times per week for 4 weeks. Both groups also performed strengthening and stretching exercises 3 times per week for 4 weeks.
Main outcome measurements: The pain level, shoulder angle and self-reported score were evaluated at pre-intervention, 2-week post-intervention and 4-week post-intervention time points.
Results: Functional performance improved after intervention in both groups ($p = 0.027$). A greater decrease in pain level was related to better functional performance of the shoulder in both groups ($r = -0.760$ and -0.674; $p < 0.010$). Moderate correlations were found for posture and functional performance of the shoulder in the intervention group (0.48).
Conclusion: Four weeks of strengthening and stretching exercises with or without kinesiology taping improved functional performance in subjects with impingement and RSP. Improvement in clinical symptoms was related to better performance of posture.

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1. Introduction

Shoulder impingement syndrome (SIS) is a common diagnosis for subjects who have pain and dysfunction of the shoulder (Windt et al., 1996). Shoulder impingement syndrome accounts for 44%–65% of all shoulder pain (Pribicevic, Pollard, & Bonello, 2009). It may affect patients of any age, but it is especially common in patients aged between 40 and 50 years (Brox et al., 1999; Hermoso & Calvo, 2009). The etiology of the syndrome is known to be multifactorial; it is caused by the interaction of intrinsic and extrinsic factors (Braman et al., 2014; Hagberg & Wegman, 1987; Neer, 1972). Poor posture and abnormal scapular kinematics have been suggested as possible factors in developing SIS and also as observed phenomena of SIS (Jobe, Coen, & Screnar, 2000). Round shoulder posture (RSP) is believed to be a factor that contributes to increases in the potential for subacromial impingement or exaggerated symptoms of SIS (Holmgren et al., 2012).

Kiruthika, Rekha, Preethy, and Abraham (2018) examined the prevalence of postural abnormalities in 804 females and reported that the most common malalignment among female college students was rounded shoulder (8.3%). Mehta, Athavale, Shyam, and Sancheti (2019) also reported in a recent study that 28.33% of truck drivers suffered from shoulder pain caused by RSP. RSP is characterized by a protracted, downwardly rotated, and anteriorly tipped position of the scapula with increased cervical lordosis and

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upper thoracic kyphosis (Magee, 2002). RSP can result from habitual and excessive trunk flexion, which places the shoulders in the forward position and results in shortness of the pectoral muscles (Magee, 2002). One of the major changes resulting from RSP is shortening of the pectoralis minor (Borstad & Ludewig, 2005; Magee, 2002). Due to its attachment on the coracoid process of the scapula, the pectoralis minor is shortened with a protracted, downwardly rotated, and anteriorly tipped position of the scapula (Borstad & Ludewig, 2005). Tightness in the pectoralis minor (PM), increased thoracic kyphosis, and altered scapula positions are related phenomena in RSP (Borstad & Ludewig, 2005; Magee, 2002). These characteristics are related to the clinical condition in subjects with SIS (Holmgren et al., 2012; Jobe et al., 2000). Moreover, Borstad (2006) suggested that the relationship between round shoulder posture and shoulder pain is based on the theory that with prolonged positional changes, soft tissues on one side of the joint will adaptively lengthen, while soft tissues on the opposite side of the joint will adaptively shorten. These soft tissue adaptations contribute to alterations of the active and passive range of motion in the shoulder, thus resulting in biomechanical changes and pain.

Kinesiology tape is an elastic tape used to adjust physiological processes such as pain, inflammation, muscle activity, and circulation (Kase, 2003). Halseth, McChesney, DeBeliso, Vaughn, Lien, (2004) proposed that kinesiology tape could increase proprioception through increased stimulation of cutaneous mechanoreceptors. Moreover, Han, Lee, & Yoon, (2015) used 35–40% kinesiology tape to immediately correct round shoulder posture in healthy seated male workers. Nevertheless, the treatment effects of kinesiology taping on the mechanical correction of shoulder impingement with RSP have not been sufficiently investigated with the simple and economical measurement tools that are available in a clinical setting such as a hospital.

Despite the treatment strategy for subjects with SIS being focused on correcting RSP, evidence to support this assumption is limited (Hajihosseini et al., 2014; Lee et al., 2015; Ruivo, Carita, & Pezarat-Correia, 2016; Struyf et al., 2013). After strengthening exercise for 6 weeks in subjects with SIS, researchers found a significant 10% decrease in RSP without investigating the clinical conditions of the syndrome (Hajihosseini et al., 2014). A 32-week resistance and stretching training program had a significant effect on decreasing RSP in healthy adolescents (Ruivo et al., 2016). Although improvement of RSP can be assumed to result from strengthening and/or stretching exercises, the duration of training is long, and the program may not be specific to subjects with SIS. On the other hand, Struyf et al. (2013) examined the effectiveness of a 12-week scapular-focused treatment in subjects with SIS. Despite moderate to large clinically important improvements in function and pain, they found no change in RSP. According to the relevant literature, most of the treatments that have focused on treating SIS by correcting RSP were exercise interventions, and the durations of interventions were more than 6 weeks. We wondered whether combining kinesiology taping with the exercise intervention could shorten the duration of intervention. In addition, verification of the effects of correcting RSP in subjects with SIS is needed.

Researchers have indicated that immediate mechanical correction of RSP could be achieved by the application of kinesiology taping (Han et al., 2015). Thus, the application of taping may add an additional effect to those of strengthening exercise plus PM stretching. The aim of this study was to compare the effects of intervention (strengthening and stretching exercises) with and without kinesiology taping. We hypothesized that strengthening and stretching exercises with kinesiology taping would lead to more improvement in RSP and the clinical symptoms in SIS subjects as compared to exercises only, and that improvement in clinical symptoms would be related to RSP.

2. Methods

According to the clinically meaningful differences and variability estimates from a 2016 study by Ruivo et al., a sample size of 18 subjects per group can provide 80% power to detect an effect size of 0.85 between 2 groups of shoulder angles at an alpha level of 0.05 with a two-tailed test using G-power. Thirty-six subjects aged 20–75 years were recruited from University Hospital. The inclusion criterion for subjects with SIS was positive results on at least 3 of 5 tests: Neer's test, Hawkin's test, Empty can test, pain or weakness with resisted external rotation test, and tenderness in tendon of rotator cuff (Hsu, Chen, Lin, Wang, & Shih, 2009; Lin, Hsieh, Cheng, Chen, & Lai, 2011; McClure, Michener, & Karduna, 2006). The criterion for RSP was acromial distance ≥2.6 cm (Sahrmann, 2002, pp. 246–261), which was measured as the distance from the table to the border of the lateral-posterior acromion when subjects were in supine position with the shoulder in neutral position. This definition of the RSP (acromial distance ≥ 2.6 cm) was adopted from Han et al., 2015. An intra-class correlation coefficient (ICC) of 0.95 was reported (Lewis & Valentine, 2007). Each patient had been diagnosed with impingement symptoms by a physician or orthopedic surgeon. In addition, patients with shoulder pain onset due to trauma, a history of shoulder fracture or dislocation, cervical radiculopathy, degenerative joint disease of the shoulder, or surgical interventions on the shoulder were excluded.

A randomized clinical trial with a blinded assessor was conducted (Fig. 1). The patient took a form (with a letter a ($n = 18$) or b ($n = 18$)) indicating allocation to either group from a closed envelope. Only the therapist had direct access to the randomization list. Subjects with SIS were randomly allocated to either the kinesiology taping/exercise group or the placebo taping/exercise group.

2.1. Shoulder angle (SA)

Each subject was asked to stand normally in a relaxed posture and to focus on an imaginary point on the opposite wall. The examiner took a photo of the profile of the body after a 5-s pause (Ruivo, Pezarat-Correia, & Carita, 2014). The photo was transferred to a computer with AutoCAD software (AutoDesk Inc., Sausalito, CA), and the shoulder angle (SA) was measured from the intersection of the line between the midpoint of the humerus and spinous process of C7 and the horizontal line (Hajihosseini et al., 2014; Ruivo et al., 2016). A lower value of SA represents more anterior translation of the shoulder in the sagittal plane. It has been reported that this measurement has good reliability (ICC = 0.78) (Ruivo et al., 2016).

2.2. Self-reported flexilevel scale of shoulder function (FLEX-SF)

The FLEX-SF scale was selected for assessment of shoulder function and disability in this study based on its assessment of the entire continuum of shoulder functions and appropriate psychometric properties of reliability, validity, and responsiveness to clinical change. The test-retest ICC for the FLEX-SF has been reported as 0.90 (Cook et al., 2003). In this scale, respondents answer a single question that grossly classifies their level of function as low, medium, or high. They then respond to only the items that target their level of function. Scores are recorded from 1, indicating the most limited function, to 50, indicating no limitation of function (Cook et al., 2003).

2.3. Procedure

The SA, pain score and FLEX-SF of all subjects were measured before they were randomly allocated to the groups. In the
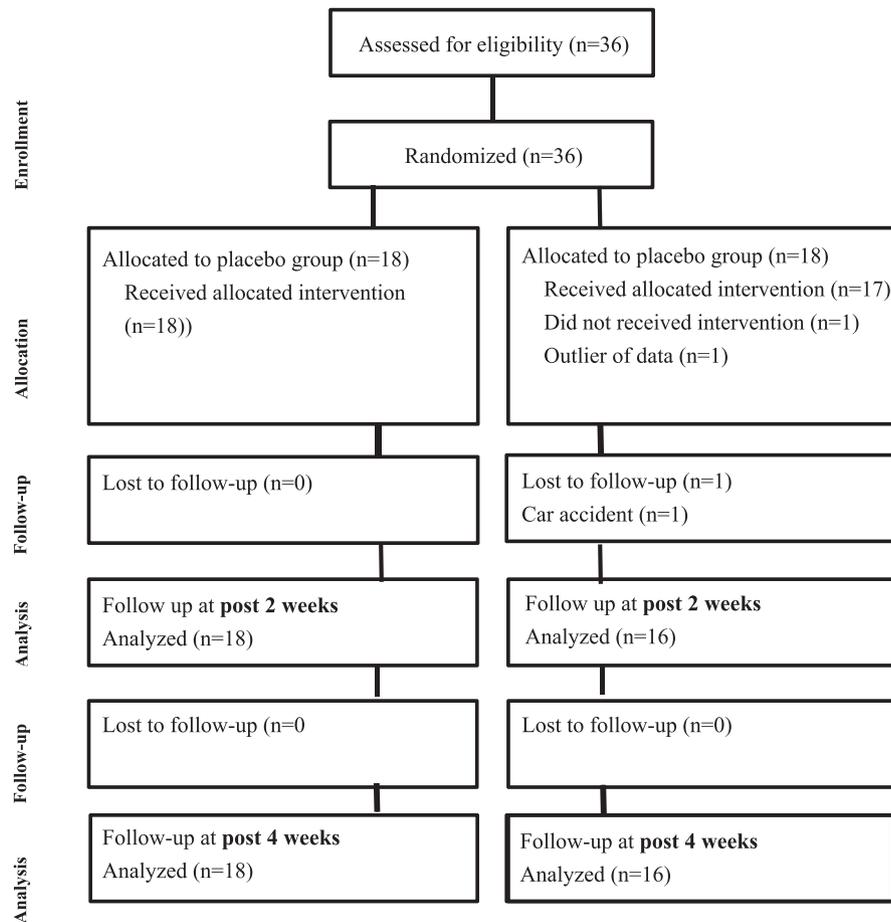
Fig. 1. Consort diagram of the study protocol. Intervention group: kinesiology taping and exercise; placebo group: placebo taping with exercise.

kinesiology taping/exercise group, three tapes were applied (Fig. 2). The first kinesiology tape (tape A) was applied with approximately 35–40% stretch, which was achieved by cutting the tape to three-quarters of the length required for taping and stretching it anteriorly at the mid third of the clavicle and placed posteriorly over the main belly of the upper trapezius and continued in the direction of
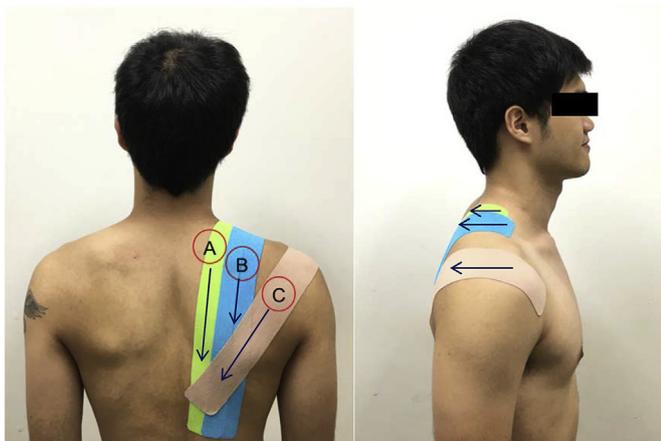

Fig. 2. Application of kinesiology tape: Tapes (A) and (B) inhibit overactivity of the upper trapezius; tape (C) corrects alignment of the scapula.

T12 down to the belly of the lower trapezius (Han et al., 2015). The second kinesiology tape (tape B) was applied with 35–40% stretch over the same area, overlaying approximately 50% of the first tape in order to enhance mechanical correction (Han et al., 2015). The third kinesiology tape (tape C) was applied with 35–40% stretch from the anterior aspect of the acromion to the spinous process of the 10th thoracic vertebra of the dominant shoulder (Smith et al., 2009). The placebo taping/exercise group performed the exercise intervention with taping, but without tension applied. For the study, taping was reapplied 2 or 3 times per week, depending on the subject's response, so as to avoid allergic reaction. The exercise protocol consisted of side-lying external rotation, prone horizontal abduction with external rotation, and prone extension, which have been demonstrated to be an appropriate exercise protocol for subjects with shoulder disorders (Cools et al., 2007). Each exercise was repeated 12 times per set, with three sets per session. Exercise was conducted in three sessions per week for four weeks. Initial exercise weights were determined based on further individualized 10 repetition maximum (RM) testing. Pain up to a visual analog scale (VAS) pain level of 5 was allowed during the 10 RM testing, provided that the pain subsided immediately after the exercise was completed. To monitor progress, ensure correct movement pattern, and control the load progression, the subjects were checked when they came to the hospital to have their kinesiology tape changed by the physical therapist 2 or 3 times per week. This type of weight training is generally adopted by the American College of Sports

Medicine to ensure efficient and safe gains in response to strength training (Kraemer et al., 2002). The stretching protocol was self-stretch, which was performed in standing position and required the subject to abduct the humerus to 90° with the elbow flexed to 90° and place the palm on a flat planar surface (Borstad & Ludewig, 2006). Outcomes were assessed before intervention and at 2 and 4 weeks during the intervention period. The investigator was blinded to the results, and a recorder noted the outcomes.

2.4. Statistical analysis

The Statistical Package for the Social Sciences (SPSS) Version 22 software (SPSS Inc, Chicago, IL) was used for data analysis. Descriptive statistics were used to present the demographic data. The change scores between pre-intervention and 2-week post-intervention (delta 1), 2-week and 4-week post-intervention (delta 2), and pre-intervention and 4-week post-intervention (delta 3) were analyzed. The Shapiro-Wilk test was performed to confirm the normal distribution of the outcome data. If a result showed non-normal distribution, then non-parametric analysis was used. For data with normal distribution, group-by-time two-way mixed model analysis of variance (ANOVA) with time as the repeated factor was used to determine the differences in the outcome data between the 2 groups. The relationships between pain, posture and shoulder performance were examined by correlation matrix on delta 1, delta 2 and delta 3 for each group. A p value less than 0.05 was considered as statistically significant.

3. Results

Thirty-six round shoulder subjects with impingement syndrome participated in this study, and 34 completed the 4-week follow-up (Fig. 1). Two subjects were lost to follow-up. One was lost because during the pre-intervention test, we found that his score on the FLEX-SF was an outlier. The other one was in an automobile accident and could not continue to participate. Finally, there were 18 subjects (female: 14) in the kinesiology taping/exercise group and 16 (female: 10) in the placebo taping/exercise group. No significant differences were noted in pain, SA or functional score between the 2 groups before intervention (Table 1).

ANOVA results are presented in Table 2. There were no 2-way (group and time) interaction ($p = 0.08$) or main effects between the groups ($p = 0.81$) in pain level. No two-way interaction ($p = 0.069$) or main effects between groups ($p = 0.574$) or among the 3 time points ($p = 0.514$) were found in SA. In FLEX-SF score, there were no 2-way interaction ($p = 0.119$) or main effects between groups ($p = 0.975$). However, a significant main effect of time ($p = 0.027$) was found. Improvement of FLEX-SF scores was found in both the experimental and placebo groups, with higher scores post intervention.

On the correlation matrix (Table 3), the pain scale (delta 3) was

found to be correlated with the functional score for both groups. A greater decrease in pain level was correlated with better functional performance of the shoulder in both the intervention group ($r = -0.76$; $p < 0.0005$) and the placebo group ($r = -0.67$; $p = 0.008$) (Fig. 3). Posture (delta 3) was found to be correlated with the pain scale in the intervention group. Better posture performance was related to pain level in the intervention group ($r = -0.60$; $p = 0.018$) (Fig. 3). Additionally, nearly moderate correlations were found for posture and functional performance of the shoulder in the intervention group (0.48 on delta 1 and delta 2) as well as for pain scale and functional performance of the shoulder in the placebo group (0.46 on delta 1).

4. Discussion

We hypothesized that pain level, shoulder posture and functional performance would improve more in the kinesiology taping/exercise group than in the placebo taping/exercise group, and that the improvement in clinical symptoms would also be related to RSP. Although we did not find differences in the outcomes between the 2 groups, the improvement in pain was significantly related to better performance of RSP (SA) in the kinesiology taping/exercise group. Improved shoulder function was also moderately correlated to better performance of RSP in the kinesiology taping/exercise group. These results partially supported our hypotheses. Additionally, improvement of functional performance was demonstrated in both groups. Significant relationships between pain level and functional performance were found in both groups.

The current study did not demonstrate an additional effect of kinesiology taping. This might have been partly due to three factors: the placebo tape also providing sensory stimulation, the large age range of our participants, and the use of difference tensions with the kinesiology tape. First, in our study, we used two groups to see whether or not the kinesiology tape would have an additional effect. In one group, tension was applied, and in the other, tension was not applied. It appears that creating a control group without tension was not sufficient as a placebo or sham control because simply applying kinesiology tape without tension provides a sensory input effect (Şimşek, Balki, Keklik, Öztürk, & Elden, 2013). Şimşek et al. (2013) compared kinesiology tape with exercise therapy and sham taping with exercise therapy. In their study, they found no significant difference between groups at the 5th day ($p = 0.563$) and the 12th day ($p = 0.116$). Simsek proposed that motor neurons were activated by the stimulated cutaneous mechanoreceptors despite the application of sham kinesiology tape. Also, Bae, Lee, Oh, and Kim (2013) showed that the application of kinesiology tape provided repetitive feedback to the cerebrum, triggering a decrease in movement-related cortical potential and positively influencing the functional movements. Therefore, the control group of "without tension" was not a powerful control group. We think that this is the main reason why this study found no additional improvement with kinesiology tape. Future research should include a non-tape group to examine the possible difference. Second, the reason for including participants with a large age range was that shoulder impingement syndrome may affect patients of any age, including the elderly (Hermoso & Calvo, 2009). A previous study noted that a possible mechanism of action to decrease pain and improve function could have an impact on ascending pathways and proprioception (Şimşek et al., 2013). However, proprioception may deteriorate with aging (Ribeiro & Oliveira, 2007). Previous studies showed a relationship between aging and declines in several aspects of proprioceptive sensitivity, including a decrease in joint position sense (Hurley, Rees, & Newham, 1998). Therefore, the elderly subjects' proprioception ability might have influenced the effects of the kinesiology tape.

Table 1
Descriptive statistics of participants.

	Intervention group (n = 18)	Placebo group (n = 16)	p value
Female (male)	14 (4)	10 (6)	0.33
Age	50 ± 13	45 ± 9	0.21
VAS	4.7 ± 1.7	5.1 ± 1.5	0.35
AD (cm)	6.3 ± 1.2	6.4 ± 1.4	0.79
SA (angle)	50.7 ± 9.5	51.9 ± 11.7	0.96
FLEX-SF	30.5 ± 2.7	31.2 ± 4.0	0.75

VAS: Visual Analogue Scale.
AD: acromial distance.
SA: shoulder angle.
FLEX-SF: Flexilevel Scale of Shoulder Function.

Table 2
ANOVA results for VAS, SA and functional score.

Outcome measurements	Delta 1 (mean ± SD)	Delta 2 (mean ± SD)	Delta 3 (mean ± SD)	Group (P value)	Time (P value)	Group*Time (P value)
VAS						
Intervention group	−0.39 ± 2.03	−0.94 ± 1.52	−1.47 ± 1.55	0.809	0.054	0.08
Placebo group	−1.47 ± 1.77	−0.07 ± 1.492	−1.87 ± 2.45			
SA						
Intervention group	5.12 ± 10.20	−5.73 ± 11.98	0.47 ± 12.83	0.574	0.514	0.069
Placebo group	−2.5 ± 12.97	1.29 ± 10.88	−1.91 ± 9.95			
FLEX-SF						
Intervention group	1.17 ± 3.15	2.88 ± 4.11	4.06 ± 4.60	0.975	0.027*	0.119
Placebo group	2.73 ± 3.65	1.14 ± 3.76	4.00 ± 5.67			

$*p < 0.05$.
VAS: Visual Analogue Scale.
SA: shoulder angle.
FLEX-SF: Flexilevel Scale of Shoulder Function.
Delta 1: change score between pre-intervention and 2-week post-intervention.
Delta 2: change score between 2-week and 4-week post-intervention.
Delta 3: change score between pre-intervention and 4-week post-intervention.

Table 3
Correlation Matrix among change scores of VAS, SA, and FLEX-SF in two groups.

	VAS1	SA1	FLEX1	VAS2	SA2	FLEX2	VAS3	SA3	FLEX3
VAS1	1.00								
SA1	0.07 (−0.002)	1.00							
FLEX1	−0.34 (−0.46#)	0.48# (0.35)	1.00						
VAS2				1.00					
SA2				−0.26 (0.47)	1.00				
FLEX2				−0.26 (−0.03)	0.48# (0.28)	1.00			
VAS3							1.00		
SA3							−0.60* (−0.02)	1.00	
FLEX3							−0.76* (−0.68*)	0.37 (−0.09)	1.00

Kinesiology taping/exercise group (Placebo taping/exercise group).
$*p < 0.05$; #: nearly moderate correlation.
1: change score between pre-intervention and week 2.
2: change score between week 2 and week 4.
3: change score between pre-intervention and week 4.
VAS: Visual Analogue Scale.
SA: shoulder angle.
FLEX: Flexilevel Scale of Shoulder Function.

Further investigation will be required. Third, the tension of the kinesiology tape might have influenced the results. According to a recent review (Lim & Tay, 2015), excessive tension might diminish the pain-relieving effects of KT. Han et al., 2015 employed 35—40% tension stretch to correct round shoulder posture. Although this is the only study on kinesiology taping for correction of shoulder posture conducted to date, further studies will be needed to find a suitable taping technique for improving the taping effect.

The intention to use kinesiology taping to have an additional effect on posture performance in subjects with SIS and RSP should be carefully considered. Han et al. (2015) found that kinesiology taping significantly increased the length of the pectoralis minor and posture measurement as compared to placebo taping. Lee et al. (2015) reported that round shoulder posture was significantly improved in scapular tilting exercise with a brace as compared to exercise only. Contrary to previous findings (Han et al., 2015; Lee et al., 2015), the current study did not demonstrate an additional effect of kinesiology taping. Interestingly, Saracoglu, Emuk, and Taspinar (2018) conducted a systematic review and did not find a taping effect in addition to physiotherapy interventions for subjects with SIS. Saracoglu et al. reported that further robust, placebo-controlled and consistent studies would be needed to determine whether exercise interventions combined with kinesiology taping are more effective than interventions without taping. Keenan et al. (2017) also demonstrated that kinesiology taping does not alter shoulder strength, shoulder proprioception, or scapular kinematics in subjects with SIS. In our data, improvement in SA (effect size = 0.5 without significant difference) was noted at 2 weeks in the kinesiology taping/exercise group. However, this effect was not maintained at 4 weeks. Additionally, the major difference between the current study and previous studies is the measurement of posture. The SA was measured after removing the tape in the current study, whereas posture measurements were taken during the application of taping or a brace in the previous studies.

For subjects with SIS and RSP, improvement in clinical symptoms is related to better posture. According to the kinematic theory of impingement syndrome (Borstad & Ludewig, 2005; Holmgren et al., 2012; Jobe et al., 2000; Magee, 2002) a protracted, downwardly rotated, and anteriorly tipped position of the scapula, which is characteristic of RSP, can decrease the subacromial space and result in impingement. Improvement of RSP can relieve clinical symptoms of impingement such as pain and limited range of motion and subsequently increase functional performance (Brink et al., 2009; Fernandez-De-Las-Penas et al., 2007). Our findings support these assumptions. Some moderate relations were found among improvement of SA (RSP), decreased pain and better functional performance in both groups. On the other hand, the 4 weeks of strengthening/stretching exercises improved functional performance in both groups. However, kinesiology taping and exercise did not demonstrate a positive effect on SA (RSP). The strengthening exercises in our protocol (side-lying external rotation, horizontal abduction with external rotation, and prone extension) are
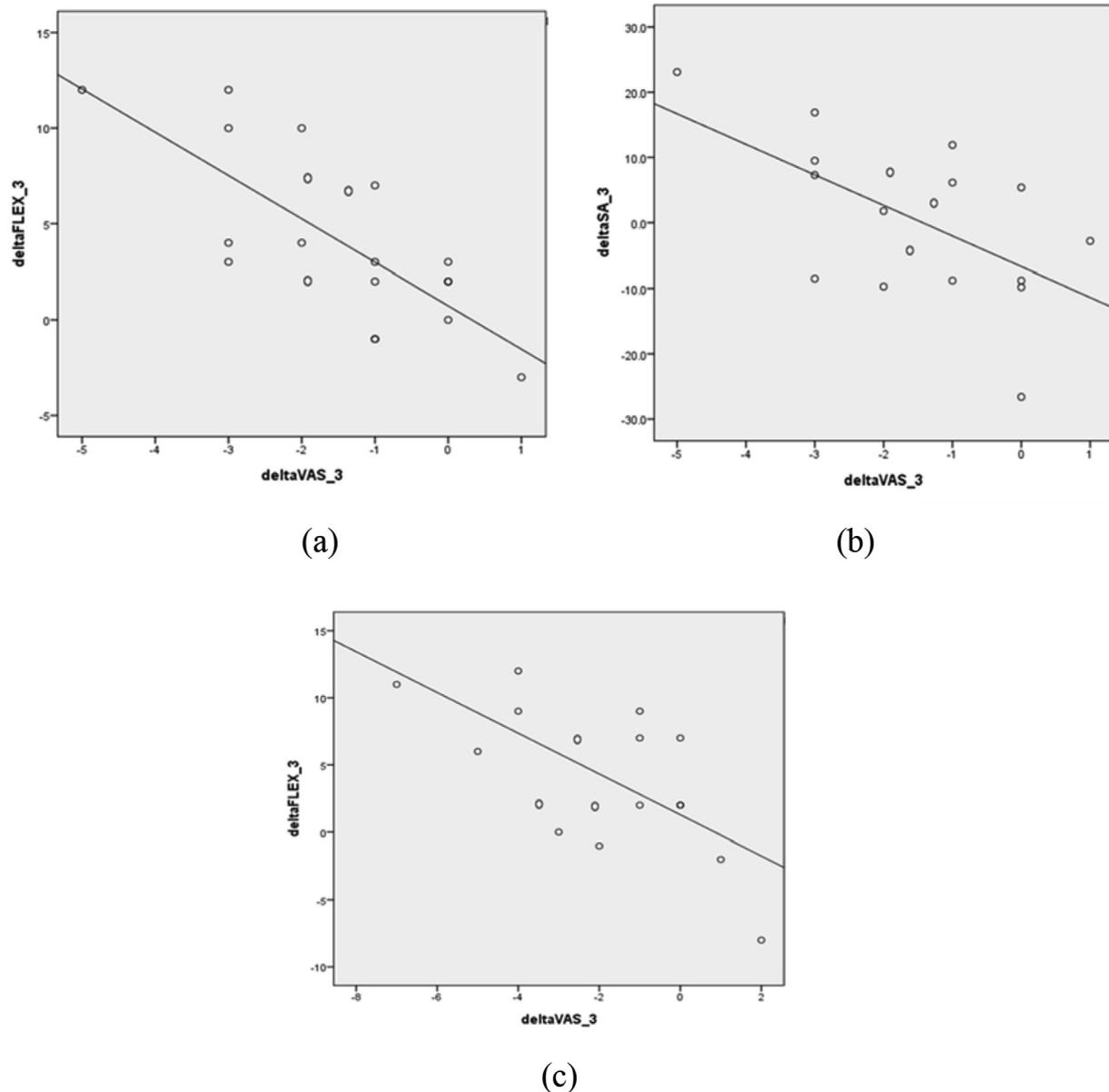
Fig. 3. Correlation between VAS, FLEX and SA for the delta 3 region in the intervention group (a) (b) and placebo group (c).

believed to promote lower trapezius and medial trapezius activity with minimal activation of the upper trapezius, which should help to reduce pain and improve function in patients with SIS (Cools et al., 2007). Although the stretching exercise in our protocol has been proposed to relieve PM tightness and improve RSP (Borstad & Ludewig, 2006), our results did not support this proposition. Future study should investigate other treatment options for correcting RSP in addition to the strengthening/stretching exercises in our protocol for subjects with SIS and RSP.

Clinical measurements of RSP should be clarified. RSP is one of the most common postural deviations in adolescents (Van Niekerk et al., 2008). Researchers have employed acromial distance, SA, and pectoralis minor (PM) length to represent RSP (Hajihosseini et al., 2014; Ruivo et al., 2016; Sahrmann, 2002, pp. 246–261). Sahrmann (2002, pp. 246–261) defined RSP as acromial distance ≥ 2.6 cm, which is the most common assessment of degree of RSP used in clinics. Ruivo et al. (2014) suggested that an individual has RSP if the SA is less than 52°. PMI is an index to reflect pectoralis

minor length in each subject and acts as alternative assessment for RSP (Borstad & Ludewig, 2005). In our study, acromial distance was employed to include subjects with RSP. The means of acromial distance in the 2 groups were 6.3 and 6.4 cm, which were higher than 2.6 cm. On the other hand, the choice of SA as an outcome measurement of RSP is based on the standing posture, which is common for most individuals during daily activities. The means of SA used to represent RSP in our outcome were 50.7 and 51.9° in the 2 groups, both of which were close to 52°. Thus, our sample may not represent subjects with RSP. Further study should clarify clinical measurements of RSP.

Limitations of the study should be noted. First, the subjects in our sample may not represent subjects with RSP. It can be assumed that the effects of kinesiology taping and exercise on posture correction may be obvious in subjects with greater severity of RSP. Four subjects with less SA (mean 42°) had positive responses with taping. Second, the duration of taping was not recorded. The participants were informed to remove the tape when they felt it was

uncomfortable or noticed an allergic response. Although the tape was replaced twice per week for each subject, the taping duration may have varied by subject. It was observed that about 20% of the subjects had removed the tape before returning to the clinic for replacement. The results may have been affected by the insufficient duration of the intervention. Third, the number of exercise sessions was not recorded for each subject. Exercise compliance was estimated to be the same between the 2 groups based on the subjects' reports at clinical visits and in telephone interviews. Thus, lack of compliance was unlikely to have affected the results.

5. Conclusions

Four weeks of strengthening and stretching exercises with or without kinesiology taping improved functional performance in subjects with SIS and RSP. However, kinesiology taping did not demonstrate an additional effect on RSP in our sample. For subjects with SIS and RSP, improvements in clinical symptoms such as pain and functional activity were related to better performance of posture. Correcting RSP should be a treatment strategy for subjects with SIS. Other treatment options in addition to kinesiology taping for correcting RSP should be further investigated.

Ethical statement

This research was approved by the Institutional Review Board at University Hospital. Informed consent was obtained from each participant.

ClinicalTrials.gov Identifier: NCT03413488.

Acknowledgements

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ptsp.2019.09.001.

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