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COMPARISON OF KINESIO TAPING AND MANUAL THERAPY WITH SUPERVISED EXERCISE THERAPY FOR THE TREATMENT OF SHOULDER IMPINGEMENT SYNDROME

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ABSTRACT

Background: Shoulder Impingement Syndrome (SIS) is a major contributing factor for shoulder pain. Although many therapists use Kinesio Taping (KT) and Manual Therapy (MT) for SIS, no such studies in combination with Supervised Exercise Therapy (SET) have been conducted in the context of Saudi Arabia. Thus, the purpose of this study is to compare the effectiveness of KT and MT with SET in patients with SIS.

Methods: Randomized controlled trial. Thirty-two subjects were assigned into two groups (KT with SET and MT with SET). The following outcome measures were measured at baseline, three weeks and six weeks. The outcome measurements are pain intensity by a numerical pain rating scale (NPRS), Active range of motion in the shoulder (AROM) by goniometry, and the functions of the shoulder measured through Shoulder Pain and Disability Index (SPADI). A simple descriptive statistical analysis was adopted to describe the patient-specific demographic characteristics with respect to outcome parameters. Within-group and between groups comparison were analyzed using ANOVA, and Scheffes' posthoc tests by using SPSS 21.0.

Results: Sixteen subjects completed treatment in each group. No differences were identified between groups at baseline. In ANOVA, it was shown that both groups significantly ($p < 0.05$) decreased pain intensity, improved function and increased shoulder AROM in the 3rd week, and 6th week. However, post hoc analysis results suggested that the KT, in conjunction with SET, had a higher proportion of change on 3rd week, of the pain intensity, SPADI, and AROM.

Conclusion: KT with SET has been found to be more effective than the MT with SET in the 3rd week and had the same effect in the 6th week of the treatment. When an immediate effect is expected, KT may be a better choice of treatment in the management of SIS.

Keywords: Shoulder impingement syndrome, Kinesio taping, Manual therapy, Supervised Exercise therapy

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INTRODUCTION

The shoulder is one of the most important joints in the human body and has a greater risk for strain and injuries than other joints in the body. Shoulder pain is the most common problem next to Low back pain, affecting around 16-21% of the population [1]. Among people with shoulder pain problems, Shoulder Impingement Syndrome (SIS) has the highest prevalence rate of 36% in shoulder disorders [2]. SIS occurs due to compression of the rotator cuff structures such as impingement of tendons or bursa as they pass underneath the coracoacromial arch during arm elevation as well as mechanical abrasion in the shoulder [3,4]. Several factors causing SIS includes acromial morphology, rotator cuff muscle weakness, joint laxity or tightness, muscle imbalance, kinematics of scapulothoracic attachment, inflammation of the bursa or tendons, and degenerative changes [5]. Rotator cuff muscle inhibition, inflammation in the supra-humeral space, altered kinematics and damage to the rotator cuff tendons tend to worsen the shoulder condition [3, 6-7].

Although many treatments are available in the management of SIS, few randomized controlled trials have been demonstrated to be effective [8-10]. Alteration of function in the scapular muscles such as the serratus anterior and the lower trapezius leads to poor shoulder function and chronic SIS [11]. It was observed in subjects with SIS, that they had overactivation of the upper trapezius and inhibition of the lower trapezius and serratus anterior muscle [12]. Presently, rehabilitation protocols prioritize the importance of restoring scapular movement control [13,14] and the importance of stabilizing the muscles surrounding the subacromial space [15,16].

In general, Kinesio taping (KT) applications play an essential role in the management of SIS. KT technique was initially invented in 1980 by Japanese chiropractor Kenzo Kase [17]. The effects of KT application is to reduce pain intensity, improve muscle function, alter the scapular position and improve the glenohumeral joint motion [18,19]. The main goals of KT application are to correct the scapular abnormality, to improve the glenohumeral motion and to regulate the scapulohumeral rhythm. It has been suggested that the regulation of the shoulder and the scapular movement, might be attained by constant proprioceptive feedback mechanism and scapular alignment control during active movements with KT [14]. It has been confirmed that KT improves the scapular proximal stability to allow free glenohumeral movements without having any pain [20]. Dr. Kase discovered different types of taping methods that resulted in the stabilization and control of the scapular muscles, altered the mechanics in the scapulohumeral rhythm, space or lymphatic correction that surrounds the shoulder complex [17].

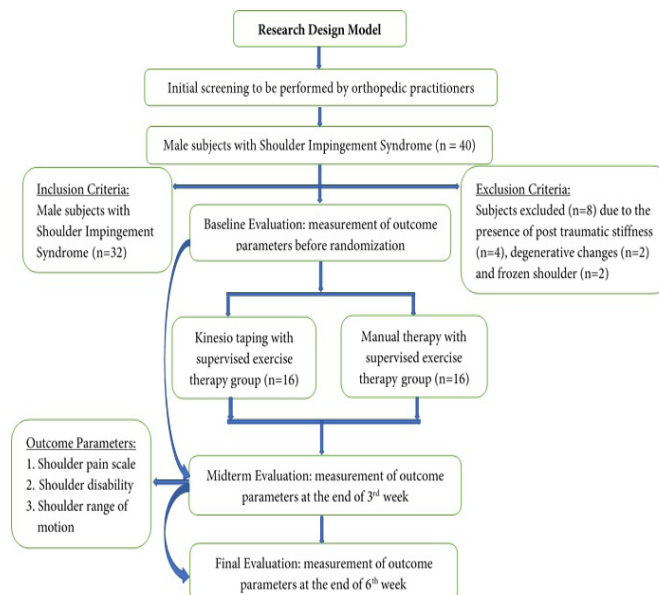
Various clinical findings associated with shoulder impingement with excessive shoulder external rotation range of motion (ROM), weak internal rotation, and decreased endurance ratios of the shoulder abductors and external rotators have been conducted [21,22]. Studies have shown that 15-28% of SIS patients may eventually require surgery [23,24]. Manual therapy such as graded mobilization tech-

nique, mobilization with movement, exercise and soft tissue technique, and deep friction massage are commonly used in the management of SIS [25]. Accessory and passive joint mobilization techniques are suggested to be an effective treatment for improving shoulder ROM in SIS patients [26,27]. One study reported that joint mobilization combined with active ROM exercises, improved shoulder passive abduction in patients with adhesive capsulitis [28]. Additionally, another study suggested that manual therapy, combined with supervised exercise therapy, alleviated Subacromial Impingement Syndrome (SAIS) by means of decreasing pain and improving shoulder muscle strength and functionality [29]. It has been proposed that manual therapy and stretching exercises aimed at the glenohumeral joint (posteroinferior soft tissue structures) and thoracic spine, seemed to be more effective in the majority of SAIS patients [30]. Thus, the objective of this study is to compare the effectiveness of Kinesio taping with supervised exercise therapy and manual therapy with supervised exercise therapy in the management of SIS during the six weeks of treatment.

MATERIALS AND METHODS

A randomized controlled trial with a total number of thirty-two subjects participated in the study, between the age group of 25-60 years old. The inclusion criteria were a pain in the shoulder with no history of major trauma, limited active and passive range of motion in the shoulder and no previous physical therapy treatment taken within the previous year. Exclusion criteria were; shoulder instability, degenerative changes in the shoulder, post-traumatic stiffness, frozen shoulder, acromioclavicular joint disorders, upper extremity and cervical spine disorders, glenohumeral subluxation, steroid injection in the shoulder over a two month period and dislocation. The patient was screened by orthopedic physical examination for shoulder tenderness, mobility, and impingement (Figure 1). The sample size assessment, with a power of 80% and $\alpha = 0.05$ to detect a difference of 20%, in the application of KT and MT with SET are strengths in this study.

Figure 1: Flow Chart Diagram for Participant Recruitment



STUDY SETTING

King Fahd Specialist Hospital and King Khalid Hospital in Tabuk, Saudi Arabia.

OUTCOME MEASUREMENT TOOLS:

A self-structured questionnaire was used to collect data relating to basic demographics such as; age, contact information, marital status, educational level, height and weight (BMI), smoking habits, dominant hand, causative factor, duration and occurrence of shoulder pain.

Numeric Pain Rating Scale (NPRS): Average pain intensity was measured on a numerical pain rating scale, where 0 represented no pain, and 10 represented the worst possible pain [31].

Goniometric Measurement for Shoulder Range of Motion (ROM): The shoulder ROM was measured in flexion, abduction and external rotation with a goniometer, while the patients were in a supine, lying position during the baseline, third, and sixth week periods [32].

Function: The shoulder functional assessment was measured by using the Shoulder Pain and Disability Index (SPADI). This is a self-reported questionnaire consisted of thirteen questions divided into two domains: five questions related to pain and eight questions related to shoulder disability [33,34].

TREATMENT PROCEDURES: Kinesio Taping (KT):

Two types of Kinesio taping procedure followed in the application of SIS (Figure 2)

- 1. Muscle Inhibition Technique:** KT was applied with 10-15% tension in the deltoid and supraspinatus muscle, from insertion to origin.
- 2. Glenohumeral (GH) Joint Mechanical Correction:** KT was applied from the anterior to the posterior part of the GH joint with 50-75 % tension.

The tape was applied to the subjects two sessions per week for six weeks. The participants were instructed to remove KT before the subsequent application [17].

Figure 2: Kinesio taping Technique



MANUAL THERAPY (MT):

MT techniques were applied to the joints and related soft tissues at varying speeds and amplitudes, by using passive accessory movements (PAM). Graded mobilization technique I-IV were used in this study. The procedures such as

scapulothoracic mobilization (Figure 3&4), glenohumeral distraction (Figure 5), inferior glide (Figure 6), posterior glide (Figure 7), and anterior glide (Figure 8), were used based on the subject's affected shoulder mobility. Grade I-II mobilizations were applied, according to the reactivity within the capsular movement. Grade III-IV mobilizations were applied when there was no reactivity, but there was capsular hypomobility.

Mobilization technique: Each technique was applied for 30-seconds at a rate of about one mobilization every 1-2 seconds, followed by a 30-second rest for three sets [35].

Figure 3: Scapulothoracic superior and inferior glide



Figure 4: Scapulothoracic medial and lateral glide



Figure 5: Glenohumeral Distraction



Figure 6: Glenohumeral Inferior Glide



Figure 7: Glenohumeral Posterior Glide



Figure 8: Glenohumeral Anterior Glide



SUPERVISED EXERCISE THERAPY (SET):

The purpose of SET was designed for the subject such as to restore normal shoulder movement through awareness, and easily transition to activities of daily living (ADL). All subjects were instructed to do self-correction and stabilization exercises for the scapula, shoulder depression during movements such as flexion, abduction and external rotation, rotator cuff muscle exercises, and pain-free ROM exercises. Each activity was individually planned. While in training, TheraBand was used as an exercise tool for most of the exercises to provide resistance, and control the scapular and shoulder movements. The SET was performed even with mild pain as possible during the starting position, ROM and chosen exercises. Most of the tasks were

done by three sets of repetitions. The same exercise protocol was used for both groups. Based on the subject's condition, stretching and strengthening exercises were given for tight and weak structures. Stretching exercises were given for thirty seconds and each exercise was repeated twice [36].

ETHICAL CONSIDERATION:

This study was approved by the Ethical Review Board, University of Tabuk. Participants received written information explaining the aims of the study and were invited to take part in the study voluntarily. Participants' confidentiality was protected at all times. Written consent was obtained from each of the participants.

DATA ANALYSIS:

A simple descriptive statistical analysis was adopted to describe specific demographic characteristics of the patient with respect to outcome parameters. Within-group and between groups, a comparison was analyzed using ANOVA and Scheffes' post-hoc tests. All the analysis was done using SPSS 21.0 version. A p-value less than 0.05 was considered significant.

RESULTS

In this study, the descriptive statistics were applied over demographic variables, and the respective results are displayed in Table 1 and Table 2. The average age of patients is observed as 44 years in Kinesio taping (KT) and 47 years in the Manual therapy (MT) group. In KT group, 44% of patients had the symptoms for three to six months, whereas 50% of patients in the MT group had the symptoms for one to three months. The majority of patients in both groups reported no sleep pain. Furthermore, the mean and standard deviation of variables such as pain scale, SPADI pain, disability and total score, shoulder flexion, abduction, and external rotation for both the KT and MT group are described in Table 3 and (Figure 9&10).

Table 1: Mean and Standard Deviation of Selected Demographic Variables

Variables	KT Group Mean ± SD	MT Group Mean ± SD
Age	44.50 ± 10.09	47.06 ± 11.36
Marital Status	1.69 ± 0.48	1.25 ± 0.45
Height	165.56 ± 5.81	160.81 ± 6.84
Weight	66.00 ± 7.17	64.94 ± 7.32
BMI	23.00 ± 6.95	24.24 ± 10.36

Data were expressed as mean ± SD

Table 2: Frequency Distribution of Selected Demographic Variables

Variables		KT Group N (%)	MT Group N (%)
Marital Status	Married	5 (31.3)	12 (75.0)
	Single	11 (68.7)	4 (25.0)
Smoking	Yes	7 (43.8)	6 (37.5)
	No	9 (56.3)	10 (62.5)

Dominant	Right	10 (62.5)	13 (81.3)
	Left	5 (31.3)	2 (12.5)
	Both	1 (6.2)	1 (6.3)
Causative	Inflammation	8 (50.0)	8 (50.0)
	Degeneration	6 (37.5)	6 (37.5)
	Traumatic	2 (12.5)	2 (12.5)
Duration	1-3 months	4 (25.0)	8 (50.0)
	3-6 months	7 (43.8)	6 (37.5)
	< 6 months	5 (31.2)	2 (12.5)
Shoulder Pain for the Past 12 Months	1 time	5 (31.3)	4 (25.0)
	2 times	6 (37.5)	7 (43.8)
	< 2 times	5 (31.2)	5 (31.2)
Steroid Injection	Yes	5 (31.2)	4 (25.0)
	No	11 (68.8)	12 (75.0)
Sleep Pain	Yes	6 (37.5)	7 (43.8)
	No	10 (62.5)	9 (56.2)

Data were expressed as number (percentage%)

Table 3: Mean and Standard Deviation of Variables for Patients in Kinesio taping and Manual therapy Group

Variables		KT GROUP	MT GROUP
Pain Scale	0 Week	5.69 ± 1.58	6.56 ± 1.50
	3 Weeks	3.69 ± 1.45	5.13 ± 1.02
	6 Weeks	1.13 ± 0.34	3.25 ± 0.77
SPADI Pain Score	0 Week	42.50 ± 5.50	55.86 ± 15.76
	3 Weeks	29.75 ± 7.98	50.13 ± 10.84
	6 Weeks	15.38 ± 10.68	43.38 ± 11.81
SPADI Disability Score	0 Week	29.37 ± 8.62	40.08 ± 12.11
	3 Weeks	17.79 ± 4.87	36.86 ± 11.50
	6 Weeks	12.02 ± 5.02	32.50 ± 11.11
SPADI Total Score	0 Week	35.62 ± 5.74	46.87 ± 8.10
	3 Weeks	24.60 ± 4.68	41.88 ± 8.38
	6 Weeks	13.52 ± 4.14	36.44 ± 8.07
Shoulder Flexion	0 Week	164.25 ± 6.01	166.50 ± 4.15
	3 Weeks	173.38 ± 2.33	168.56 ± 5.47
	6 Weeks	177.31 ± 2.57	172.25 ± 5.22
Shoulder Abduction	0 Week	167.25 ± 7.46	165.81 ± 5.87
	3 Weeks	172.81 ± 4.37	169.94 ± 5.79
	6 Weeks	178.19 ± 1.60	173.00 ± 4.38
Shoulder External Rotation	0 Week	77.81 ± 5.28	74.56 ± 7.72
	3 Weeks	83.00 ± 4.56	78.50 ± 7.54
	6 Weeks	88.06 ± 1.95	81.63 ± 8.25

Data were expressed as mean ± SD

Figure 9: Pre, Mid and Post Scores of Kinesio taping Group

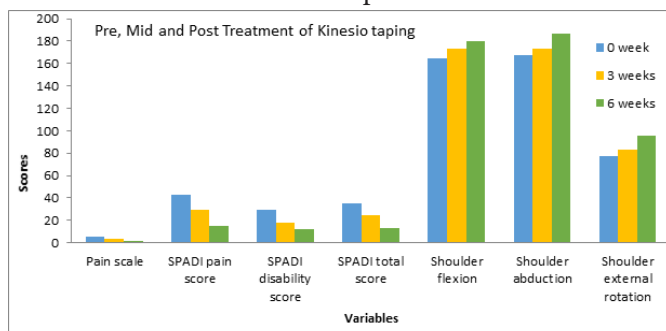


Figure 10: Pre, Mid and Post Scores of Manual therapy Group

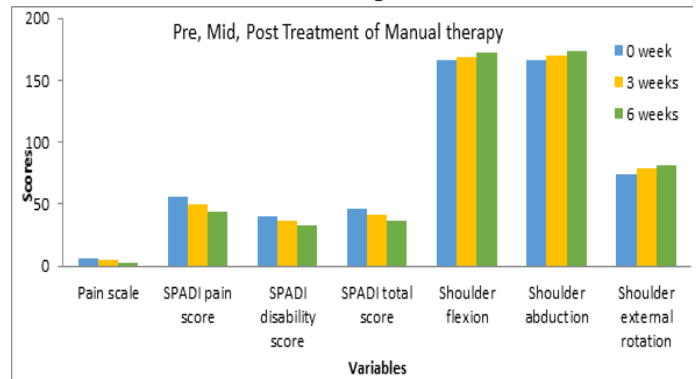


Table 4: ANOVA Showing the Difference Between Time Intervals in Variables in Kinesio taping and Manual therapy Group

Variables Mean Square		KT Group		MT Group	
		F (p value)	Mean Square	F (p value)	
Pain Scale	Between weeks	83.688	53.323* (p=0.000)	44.146	33.850* (p=0.000)
	Within weeks	1.569		1.304	
SPADI Pain Score	Between weeks	2946.583	42.489* (p=0.000)	626.333	3.718* (p=0.032)
	Within weeks	69.350		168.472	
SPADI Disability Score	Between weeks	1250.197	30.415* (p=0.000)	231.543	4.225* (p=0.041)
	Within weeks	41.105		134.199	
SPADI Total Score	Between weeks	1953.754	81.447* (p=0.000)	435.549	6.505* (p=0.003)
	Within weeks	23.988		66.953	
Shoulder Flexion	Between weeks	1046.083	64.090* (p=0.000)	135.771	5.480* (p=0.007)
	Within weeks	16.322		24.776	
Shoulder Abduction	Between weeks	1592.313	53.030* (p=0.000)	208.146	7.164* (p=0.002)
	Within weeks	30.026		29.053	
Shoulder External Rotation	Between weeks	1302.646	65.264* (p=0.000)	200.396	3.261* (p=0.043)
	Within weeks	19.960		61.460	

* Significant at 0.05 level

From Table 4, it is observed that a significant difference exists between the values taken at three different intervals (i.e. first week, three weeks and six weeks) with respect to all variables pain scale, SPADI pain, disability and total score, shoulder flexion, abduction, and external rotation in the KT group ($p < 0.05$). Furthermore, the MT group also showed a significant difference between the values taken at three different intervals with respect to all variables ($p < 0.05$). As significant differences were revealed, a Scheffe's post hoc test was further applied to discover whether the significant differences existed within the group by comparing the values of all the variables in the two different time intervals.

Table 5: Scheffes' Post Hoc Test Revealing the Mean Difference of Variables Between Time Intervals in Kinesio taping Group and Manual therapy Group

Variables	Mean Mean Difference		KT Group		MT Group	
			Significant (p value)	Mean Difference	Significant (p value)	
Pain Scale	Pre	Mid	2.000	0.000*	1.438	0.000*
	Pre	Post	4.562	0.000*	3.313	0.000*
	Mid	Post	2.562	0.000*	1.875	0.000*
SPADI Pain Score	Pre	Mid	12.750	0.000*	5.750	0.462
	Pre	Post	27.125	0.000*	12.500	0.000*
	Mid	Post	14.375	0.000*	9.750	0.000*
SPADI Disability Score	Pre	Mid	11.578	0.000*	3.203	0.738
	Pre	Post	17.359	0.000*	8.578	0.032*
	Mid	Post	5.781	0.048*	5.375	0.001*
SPADI Total Score	Pre	Mid	11.023	0.000*	4.998	0.236
	Pre	Post	22.100	0.000*	10.431	0.003*
	Mid	Post	11.076	0.000*	7.433	0.041*
Shoulder Flexion	Pre	Mid	9.125	0.000*	2.063	0.508
	Pre	Post	16.125	0.000*	5.750	0.000*
	Mid	Post	7.000	0.000*	4.688	0.000*
Shoulder Abduction	Pre	Mid	5.562	0.023*	4.125	0.108
	Pre	Post	19.375	0.000*	7.188	0.002*
	Mid	Post	13.812	0.000*	4.063	0.015*
Shoulder External Rotation	Pre	Mid	5.187	0.008*	3.938	0.373
	Pre	Post	17.562	0.000*	7.063	0.000*
	Mid	Post	12.375	0.000*	5.125	0.001*

* Significant at 0.05 level, Pre – 0 weeks, Mid – 3 weeks, Post – 6 weeks

Table 5 showed that the mean difference in values of all variables in the KT Group, which was measured between the first and third weeks, found a significant level of 0.05. Also, the mean difference measured between the third and sixth week as well as between the first and sixth week is significant at a 0.05 level, with respect to all variables in KT Group. However, in the MT Group, the results revealed that the mean difference in pain scale values between the first and third weeks was a significant 0.05 level. Additionally, the mean difference of pain scale values measured between the third and sixth weeks, as well as between the first and sixth week was also a significant 0.05 level. However, the mean difference of values taken only between the first week and the sixth week and between third and sixth week was found to be significant ($p < 0.05$) with respect to SPADI pain, disability and the total score for, flexion, abduction and external rotation. Likewise, the mean difference of SPADI pain, disability and an overall score, flexion, abduction and external rotation measured between the first week and the third week are noted to be non-significant in the MT group ($p > 0.05$).

DISCUSSION

This study evaluated the effectiveness of a six weeks intervention on KT and MT groups with SET in the management of SIS. In ANOVA, both groups' pain intensity, shoulder AROM, and SPADI function showed significant improvement. However, post hoc analysis results suggested KT in conjunction with SET had a higher percentage of change in the 3rd week with respect to shoulder pain in-

tensity, AROM and SPADI function while having a similar effect with the MT group on the 6th week of treatment. In physical therapy management of shoulder problems, it is emphasized that the first aim of the treatment is to reduce pain, regain shoulder movement by teaching the subject how to properly place the humeral head in the center and restore normal movement patterns by scapulohumeral rhythm. Skolimowski et al. (2008) explained in his study, the gradual increase in the active shoulder ROM [37] and Kromer et al. (2009) found that exercise therapy assisted by physical therapists, were declared as an essential treatment in the management of SIS [38].

In this study, two different therapeutic interventions (KT with SET and MT with SET) were selected for the treatment within the framework of these principles. There were no statistically significant differences between the two groups in pre-treatment evaluation; which indicates that the patients in both groups were identical. With the use of both interventions in this study, neuromuscular remodeling, rapid control of pain and improve function were intended, so that prescribed supervised exercise therapy measures were applied at an earlier part of the treatment. The improvement of less pain was shown significantly in both groups. The findings are consistent with other studies such as previously reported studies have shown progress in pain reduction, increased ROM and function by KT [39-43].

Clinically, different types of taping procedures have been used for shoulder problems. Kinesio taping is an alternative choice of treatment during the shoulder rehabilitation program in order to progress functional recovery. In our study, KT with SET group shown significant reduction in pain intensity and improved shoulder ROM and function. The above findings are consistent with other studies such as Lumbroso et al. (2014) who believed that KT plays an important role in regulating muscle tone by applying tension to the fascia [44] and increases ROM by reducing the tension between fascial layers and increasing interstitial space [45]. Simoneau et al. (1997) suggested taping improved proximal scapular stability in the management of anterior shoulder impingement [46]. Kneeshaw (2002) proposed that based on pain gate control theory concepts, Kinesio tape stimulates neuromuscular pathways through increased afferent feedback and reduced pain in the shoulder region [47]. Another study conducted by Thelen et al. (2008) showed the immediate effect of Kinesio taping may also be due to space correction or lymphatic improvement in the affected shoulder region. Furthermore, KT increases the space in the subacromial region as well as stabilizing the scapular muscles throughout the range of GH elevation movement [48]. Such an increase in the subacromial space may lead to a reduction in pain intensity during movement.

Participants in the MT group, received shoulder joint mobilization with SET. Scapulothoracic glides, Glenohumeral joint distraction, inferior, anterior and posterior glides, were evaluated by the outcome measurement of shoulder flexion, abduction and external rotation were evaluated by the goniometric method. There was a significant improvement in the MT group with SET in the 6th week

of pain intensity, ROM and SPADI function in SIS. This is consistent with the findings of other studies by Conroy and Hayes (1998) and Bang and Deyle (2000), where the authors found significant pain reduction in the shoulder when subjects received joint mobilization technique in combination with SET compared to those received exercise therapy alone. However, in both studies no control group was used [5,49]. Senbursa et al. (2007) revealed that subacromial impingement syndrome (SAIS) patients treated with joint mobilization techniques along with SET, showed significant improvement in pain reduction, improve muscle strength and function prior than with only an exercise program [29].

Results also revealed that a statically significant improvement in the KT intervention group over the MT intervention group on the SPADI function test in the 3rd week and a similar effect in the 6th week with the MT group from the baseline. The inference of this result may suggest that the effective application of KT, decreased pain intensity, particularly during an activity, and the performance of exercise improves the functional recovery, when comparing to MT group. Appropriate instruction and feedback by the physical therapist to correct shoulder dysfunction and initiate motivation for regular exercise may be an essential element of 'SET'. These study results are consistent with other studies such as Engebretsen and his colleagues (2009) who found the effect of supervised exercise therapy in subjects with SIS showed significant improvement was within six weeks [50]. Maenhout et al. (2013) revealed in his study that the first six weeks of supervised exercises shown the largest improvement in SAIS [51]. In the current study, subjects in KT with SET showed better improvement on the SPADI during the 3rd and 6th week, as well as MT with SET showing minimal improvement during the 3rd week and better improvement during the 6th week of treatment. In summary, the physical therapy interventions of Kinesio taping in conjunction with supervised exercise therapy resulted in remarkable improvements in improving shoulder range of motion, function and decreasing pain in the third week of shoulder impingement syndrome.

CONCLUSION

Kinesio taping with Supervised Exercise therapy has been found to be more effective than the Manual therapy with Supervised Exercise therapy in the 3rd week and had the same effect in the 6th week of the treatment. When an immediate effect is expected, Kinesio taping may be a better choice of treatment in the management of Shoulder Impingement Syndrome.

RECOMMENDATION

The effect of these measures is to be tested in a larger sample study.

LIMITATIONS

A limitation of this study is the moderately small sample size, which was also limited to male subjects. This may limit the generalizability of our findings. No control group included in this study. Furthermore, the authors were interested to see the short-term progress in this study, especially in the 3rd week and 6th week which was a keystone in-

dicator in order to observe the soft tissue healing. Another limitation is, the shoulder ROM limited only with flexion, abduction and external rotation.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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