Reducing Muscular Strain in Rehabilitation Personal by Using the Kinesio Taping Technique

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Abstract

At present, the number of patients suffering from injuries caused by accidents, physical overload or other diseases reaches levels that represent serious problems for the socio-economic health systems and the individuals in their private lives. This evolution creates a serious burden for the physiotherapist and the rehabilitation expertise, trying to reduce the consequences in seriousness as in the convalescence periods. The objectives of this study were: 1) To examine the physiological strain of the rehabilitation personnel during the daily treatment tasks. 2) To evaluate the effects of Kinesio Taping technique in reducing muscle strain in the shoulder region. Thirty rehabilitation (female=13,male=17) experts aged 31 ± one year from the state hospital in the Bangkok area voluntarily participated in the study. They were asked to apply 20 minutes treatment during which muscular strain is assessed by the surface EMG technique of the Upper Trapezius and Anterior Deltoid (NKT) both left and right side (LT, RT, LD, RD). After each treatment session, they rested for 15 minutes and started to treat the same patient again with the implementation of the KT tape (Y shape) with inhibitory technique at the same muscles (KT) and another 20 minutes treatment followed by a 15 minutes rest. During the treatment, muscle strain and cardiac load were measuring and included: %MVC, MPF, DMPF, and %CVL. Before and after treatment, muscle capacity (MVC), and muscle fatigue (MPF, DMPF) were evaluated, as well as the rated perceived work strain (SWI) and NRS (Numeric rating) after the treatment. The results demonstrate an average level of muscle- and cardiac strain during treatment with and without KT technique (Muscle workload of more than 15% MVC, Cardiovascular load reach a level of over 30%CVL). The Kinesio tape technique does not affect the physiological response in the shoulder region during a repetitive treatment in the rehabilitation personal. The effect of applying of KT during the treatment showed a significant difference with NKT in all of the selected muscles (p<0.05). The capacity of all muscles is decreased after treatment in both techniques without and with KT application. The other results - muscle strain, cardiac strain and SWI – confirmed the findings. Rehabilitation personnel rated KT technique as a positively perceived pain score**.** However, the comparison of the impact results of various types and tapes-shapes, have to be confirmed by a larger sample size.

Keywords: *Kinesio Tape (KT), EMG, muscle strain, Numeric rating scale (NRS), SWI, Rehabilitation personals*

บทคัดย่อ

ปัจจุบันจำนวนผู้ป่วยบาดเจ็บจากอุบัติเหตุจากการทำงานหนัก หรือจากภาวะโรคต่างๆ มีจำนวนเพิ่มขึ้นและส่งผลกระทบต่อระบบสุขภาพ สังคมและเศรษฐกิจรวมถึงการใช้ชีวิตส่วนบุคคล ปัญหาเหล่านี้สร้างภาระงานให้กับนักกายภาพบำบัดและบุคลากรเวชศาสตร์ฟื้นฟูเป็นอย่างมาก ในความพยายามช่วยเหลือผู้ป่วยที่เพิ่มขึ้นทุกวัน การศึกษาในครั้งนี้จึงมีวัตถุประสงค์คือ 1) เพื่อศึกษาผลของความเครียดร่างกายของบุคลากรเวชศาสตร์ฟื้นฟูขณะปฏิบัติงานประจำวัน 2) เพื่อศึกษาผลของ ไคเนซิโอเทป(Kinesio Tape) ในการช่วยลดผลของความเครียดของกล้ามเนื้อบ่า และไหล่ โดยกลุ่มตัวอย่างเป็นอาสาสมัครบุคลากรเวชศาสตร์ฟื้นฟู จากโรงพยาบาลในกรุงเทพมหานคร จำนวน 30 คน (ชาย 17 คน, หญิง 13 คน) มีอายุเฉลี่ย 31±1 ปี ในการศึกษานี้อาสาสมัครจะให้การรักษาผู้ป่วยเป็นเวลา 20 นาทีโดยการไม่ติดไคเนซิโอเทป (NKT) และวัดค่าความเครียดกล้ามเนื้อบ่าและไหล่ ทั้งด้านซ้ายและขวา โดยคลื่นไฟฟ้ากล้ามเนื้อชนิดบันทึกที่ผิวหนัง หลังให้การรักษาทำการพัก 15 นาที และให้การรักษาซ้ำโดยติดไคเนซิโอเทป (KT) รูปแบบตัววาย (Y) ด้วยเทคนิคยับยั้ง(Inhibitory) ที่กล้ามเนื้อมัดบ่าและไหล่ จากนั้นทำการรักษา 20 นาทีและพัก15นาที ขณะทำการรักษาทำการบันทึกและประเมินความล้าของกล้ามเนื้อและภาระงานหัวใจ ได้แก่ ค่า (%MVC, MPF, DMPF และ %CVL) ช่วงก่อนและหลังการรักษาทำการประเมินค่าความแข็งแรงสูงสุดของกล้ามเนื้อ (MVC) และความล้าของกล้ามเนื้อ (MPF, DMPF) บ่าและไหล่ และสอบถามความรู้สึกเครียดที่เกิดจากภาระงาน (SWI) รวมถึงตรวจสอบอาการปวดเฉพาะจุด ด้วย NRS ขณะใช้และไม่ใช้ไคเนซิโอเทป ผลการศึกษาพบว่าบุคลากรมีความล้ากล้ามเนื้อและค่าภาระงานหัวใจอยู่ในระดับปานกลางขณะให้การรักษาในขณะที่ใช้และไม่ใช้ไคเนซิโอเทป ภาระงานกล้ามเนื้อมีค่ามากกว่าร้อยละ 15% ภาระงาน

หัวใจมากกว่า30% จากผลการศึกษาพบว่า ไคเนซิโอเทป ไม่ได้ช่วยลดความเครียดของกล้ามเนื้อบ่าและไหล่ขณะให้การรักษาแบบซ้ำๆ ผลการตอบสนองทางสรีรวิทยาขณะที่ติดและไม่ติดไคเนซิโอ เทปขณะรักษามีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ (p<0.05) ค่าความแข็งแรงสูงสุดของกล้ามเนื้อทุกมัดมีค่าลดต่ำลงภายหลังการรักษา ทั้งขณะที่ติดและไม่ติดไคเนซิโอเทป ผลการศึกษาค่าความล้ากล้ามเนื้อ ค่าภาระงานหัวใจและความรู้สึกล้าอันเนื่องมาจากการทำงาน (SWI) ยืนยันสอดคล้องกัน อย่างไรก็ตามกลุ่มตัวอย่าง ให้ระดับคะแนนการทดสอบระดับความรู้สึกเจ็บปวดของกล้ามเนื้อที่น้อยลงในการติดไคเนซิโอเทป ในอนาคตควรมีการศึกษาเพิ่มเติมด้านการใช้ไคเนซิโอเทป ในลักษณะและรูปแบบอื่นๆ และยืนยันผลด้วยกลุ่มตัวอย่างที่มีขนาดใหญ่ขึ้น

คำสำคัญ : *ไคเนซิโอเทป คลื่นไฟฟ้ากล้ามเนื้อ ภาระงานหัวใจ ความเครียดของกล้ามเนื้อ แบบบอกความรู้สึกเป็นตัวเลข แบบสอบถามความรู้สึกจากภาระงาน บุคลากรเวชศาสตร์ฟื้นฟู*

1. Introduction

Rehabilitation is an important medical technique to treat the physical disability of patients to restore their psycho-somatic capacities or functional abilities allowing them to return to their normal every-day occupations. According to the Non-Communicable Diseases (NCD) from Thawon Maton (2014), the number of NCD patients will increase doubled by 2020, which will increase the workload for the therapists or the rehabilitation teams. Physical therapy has a high repetitive character and requires continuous movements of the upper extremities, and includes a great responsibility. These factors may create mental strain, fatigue, and repetitive injury- risks for the rehabilitation staff.

As mentioned earlier, the imbalance between workload (increasing number of patients and a status or a limited increase in the number of the physical therapist (one of the rehabilitation staff) and the capacity may create risks for physical and mental strain for the rehabilitation staff and the efficiency of the treatment. Ultimately, the physiotherapists may become patients themselves, as Nor Azlin (2011); Obembe et al., (2009) reported injuries in physiotherapy staff from an overload in the musculoskeletal system. Common risks in many production processes as in rehabilitation concern the human movement system. The terminology are varied almost limitless as the more general MSD (Musculo-Skeletal Disorders), CTD (Cumulative Trauma Disorders),OOS (Occupational Overuse Syndromes) or RSI (Repetitive Strain Injuries) or the more detailed disorders as CTS (Carpal Tunnel Syndrome), LBP (Low Back Pain), TOS (Thoracic Outlet Syndrome) TNS (Tension Neck Syndrome) and so forth. They refer to an overload of the muscle-tendon systems.

The studies of injuries from working conditions that cause muscle pain show symptoms in wrist and fingers-muscles, in the back, neck and shoulder region and the legs (West and Gardner, 2011). Many studies were focused on LBP (low back pain) and lifting heavy weights (Min-Hyeok Kang et al., 2013), but were an increasing issue for shoulder pain or -injuries (Nor Azlin, 2011). Several methods treated the injuries of the musculoskeletal system to restore the capacities through massage, muscle stretching, injections and acupuncture (dry needling) (Garcia-Muro et al., 2009). However, to prevent future injuries for healthy subjects as for those who were already injured - another way to anticipate overload is the use of Kinesio Tape - that may relieve the intensity of the impact on the active muscles.

The method of Kinesio Taping - initially designed as a technique for rehabilitative objectives - can therefore also be used as a defensive tool as it is intended to facilitate the body's natural movements. Kinesio Taping (KT) provides support, stability to muscles and joints, maintains the ranges of motion, reduces pain and inflammation, increases the blood circulation, and reduces the intensity of muscle activity (Mostafavifr et al., 2012).

Kinesio Taping is also applied in clinical practices for patients with other diseases such as Stroke, Lymphedema (Morris, Jones, et al., 2013). Moreover, provides a better quality of life in the elderly (Pyszora et al., 2010). Recently Bassett, Lingman, and Ellis (2010) studied the properties of Kinesio Tape and reported that it would help to reduce injuries and muscle strain, and therefore an interesting clinical application. At present, there are no empirical data available to prove the efficiency of Kinesio Tape in the prevention of repetitive strain injuries (RSI) or (MSD). Therefore, this study may contribute to evaluate the impact of KT on the physiological strain in the shoulder muscles of physiotherapists during perform the traditional treatment processes and to prevent injuries and disorders of the musculoskeletal system in

rehabilitation personnel. The study uses a system approach in which physiological strain is measured to evaluate the impact of the KT-use on the physical capacities of the therapists.

2. Objectives

The project purposes are:

1) to study the physiological response and risk assessment of shoulder muscles in work conditions for the rehabilitation personal as a physical therapist.

2) to compare the effects of the Kinesio Tape during work on the shoulder muscles of these rehabilitation personals.

3. Materials and methods

This research is an experiment design study. This research studied the relationship between work stress factors, the individual capacity, and the physiological responses according to Stress-Strain concept. The 'Stress-strain' concept includes the connection between the factors that cause work-stress (external factors) on the therapist's individual physiological response (internal factors, strain). This principle based on the 'stimulus and response' system following the "Selye" stress model (Yoopat, 2002). The principle of 'man-at-work' represents a system in which the external load (work or stress factors) is inherent to the job from tasks, organization and environmental conditions (stressors) to which the psycho-somatic human operator is exposed. (Yoopat, 2008; Vanwonterghem, 1985).

A single approach to muscular workload assessment by evaluating the external stress factors did not fully satisfy because of missing the important inter-and - individual differences in capacities and the behavior related workload. To avoid general physical fatigue, the average muscle capacity in dynamic contractions should not exceed 20% of maximal muscular capacity (MVC) over an extended period (Yoopat, 2008; Kroemer and Grandjean, 1999). Kinesio Taping Technique (KT) is used to treat injuries in the musculoskeletal system, and in reducing the workload in muscles, joints, and fascia; can stimulate sensory motor, although some side effects (allergic reactions to rubber or latex even an irritation) may occur at low levels (Kase, 2003). KT may apply in the several therapies such as in lymphatic techniques, correction, fascia, muscle, and pain relieving techniques (Kase et al., 2003). The technique was developed by Dr.Kenzo Kase (2003) in Japan, more than 25 years ago (Mehran, 2012), and has been popular in sports at the Olympic Games.

Experimental Protocol

The subjects were the rehabilitation personal 30 subjects (male =17 and female=13) of the state and private hospitals active as a physiotherapist. Their age was 31±1 years, with a work experience of 8±5 years. A preliminary physical examination by a neutral physiotherapist included a test for pain at trigger points of the Upper Trapezius and Anterior Deltoid muscles. Subjects also rated after treatment their experienced pain level on the numeric scale 'NRS' from 0 (no pain) to 10 (very painful) (Francisco et al., 2010; Farrar et al., 2001).

Inclusion criteria in this study are as the following; a) healthy physiotherapist have a trigger point at the Upper Trapezius or Anterior Deltoid muscles at least 1 area, b) have pain score level over 2 from 10, c) all subjects have no surgical history or trauma in this area, and no medical drugs about muscle problems. d) they are voluntarily participated in the project.

This research project used the "Complete block design" method. Thirty subjects were assigned randomly as an odd or even number. All treated one patient for 20 minutes followed by a rest period of 15 minutes. During treatment, surface EMG of the Upper Trapezius and the Anterior Deltoids was measuring on both sides (with Kinesio tape (KT) or without Kinesio tape (NKT). Then treated the same patient again for another 20 minutes followed by another 15 minutes rest with applying surface EMG on the same muscles; KT or NKT along the line of muscle fiber. The odd number would start with NKT whereas the even number began with KT.

*Experimental Procedure***:** There are 3 phases of experimental procedures**:** Pre-Treatment, Treatment, and Post-treatment. Measurement and assessment included 1) the maximal voluntary muscle capacity (MVC),

2) the perceived pain score (Numeric Rating Scale or NRS), and 3) the Subjective Workload Index (SWI) questionnaire (Yoopat et al., 2012) at pre and post treatment.

1) The MVC expressed in microvolts, was measured using the electromyography ME6000P (MEGA Electronics (Finland): the Trapezius muscle during lifting their shoulders vertically as high as possible against a resistance manually given by an experienced researcher. The MVC test of Deltoid muscle was examined by lifting the straight arm up in front of the body against the resistance of the investigator.

2) Subjects were rated their perceived score on a 10-point numeric rating scale (NRS) after treatment: 0 means the lowest negative or positive scores, ten the highest discomfort or the most appreciated factors.

The SWI questionnaire is composed of 6 negative and two positive factors characterizing the personal effort-experiences: the negative factors are the perceived levels of fatigue, risk, concentration, complexity, work rhythm, and responsibility; the as positive perceived factors: work satisfaction and autonomy.

Subjects rate their perceived score on a 10-point scale after treatment: 0 means the lowest negative or positive scores, ten the highest discomfort or the most appreciated factors. The SWI score is then calculating the sum of negative score minus the sum of positive scores, divided by 8. The SWI score is interpreting as follows; SWI < 1 means no discomfort at all. SWI >1- < 2 means slight discomfort. SWI >2 - <3 means moderate discomfort. SWI >3 - < 4 means annoying and measures are needed to relieve discomfort within a period of a month. SWI >4 - <5 means very annoying, measures are needed to reduce discomfort within one week; SWI >5, intolerable, measures to relieve discomfort immediately.

During the treatment, the physiological strain was registered and evaluated by mean of heart rate, %CVL. The relative cardiovascular load (%CVL) was calculated on the basis of HR according to Vanwonterghem et al. (2002). The CVL formulation is %CVL =100 [HRwork-HRrest)]/HRmax(8hr)], where HRwork- mean HR in the job during various task performance, HRrest- mean the lowest HR registered during sit position for 10 minutes, HRmax (8hr) - mean maximum acceptable HR for work shift of 8 hrs, that is 1/3(220-age)+HRrest. The %CVL value are classified as follows: CVL< 30 % means acceptable level, 30-60%CVL means moderate level and peak loads should be reducing within a periods of months, 61-100%CVL means high level and peak loads should be reducing within a periods of weeks; >100%CVLmeans intolerable high level, peak loads should reduce immediately, or should stop working.

For the muscle activity, the % MVC (µV.) of Upper Trapezius and Anterior Deltoid muscles both left, and right side, MPF, and fatigue DMPF (Hz.) were measured and calculated (Yoopat, Maes, Poriau, and Vanwonterghem, 2015). The Median Power Frequency (MPF) indicator for muscle fatigue - obtained during treatment, and 15 minutes recovery period for M. Trapezius and M. Deltoids - express the differences in muscle conductive velocity and synchronization of motor units resulting in a shift to a lower frequency. DMPF is different of frequency change (MPF) over the period and during the treatment. A negative value reflects the degrees of fatigue: the lower the value, the more the fatigue level. Positive values indicate an improvement.

The patients in this study were left hemiplegic patients with a body weight range of 50-60 kg. The 20 minutes treatment of patients included the repetitive movement of patients with a passive range of motion (PROM) technique.

Kinesio Tape causes the skin lifting thus increasing the epidermis space which decreases an inflammation of the affected areas. According to the benefit are an increase in movement and blood circulation, relief pain over the problem areas.

Kinesio tape application technique is as follows**:** in this study, the inhibitory technique using of KT with Y shape was applied. The experimental group was treated with Kinesio tape on the Upper trapezius (LT, RT) and Anterior Deltoid muscles (LD, RD) by Kinesio Tex Gold® (Marathon company). The application of the tape with the direction in “Y” shape from insertion to origin (Kaya et al.,2011; Wei-

Ting et al.,2015) was on those muscles. The tension applied to Kinesio tape is set at 50% (Wang et al., 2008; Simsek, 2013)

Statistical analysis : The descriptive statistics of means and standard error of means (SE.) were using. The the pair *t*-test statistic was use to compare the effect of KT and NKT on reducing muscle strain and the capacity parameters before and after treatment .

Figure 1 a) Kinesio Tape application and surface EMG electrode placement, b) Treating with PROM technique

4. Results

4.1 Physical characteristics:

Subjects in this study were 17 male and 13 female physical therapists working in a state and private hospital for 8±5 years. Their age, weight height, BMI and rest heart rate are respectively 31±1.1 years, weights 65.50±2.37 kg., height 167.30±1.70 cm., BMI 23.34±0.66, resting heart rate (RHR) 77.33±1.41 bpm. (Table 1). All participants were in a good general health condition except there was some mild pain of trigger points at the upper shoulder of the participants.

Table 1 Physical characteristics of rehabilitation personal

Parameter	Mean	SE.
Age (years)	30.97	1.10
Weight (kg.)	65.50	2.37
Height (cm.)	167.30	1.70
BMI	23.34	0.66
RHR (beats/min.)	77.73	1.41
Experience (years)	8.43	5.51

4.2 Pre and Post Treatment

1) Maximal capacity test (MVC)

Table 2 shows the muscle capacity before treatment of NKT and KT. The average microvolts of all muscles in NKT group was significantly higher than those of KT group (p<0.01).

Table 2 Compare maximum capacity between NKT and KT group before working with Average EMG (µV.), MPF, DMPF (mean±SE) of Trapezius left (LT), right(RT) , Deltoids left (LD), right (RD)

EMG	NKT	KT	95%CI		*T*	*p*-value
			lower bound	upper bound		
MVC(µV.)						
LT(1)	390.70±39.21	303.60±17.82	209.254	743.433	2.559	*0.016**
RT(2)	367.30±44.37	316.93±31.23	192.617	791.275	2.539	*0.017**
LD(3)	530.90±46.25	411.87±27.89	266.542	834.809	3.397	*0.002***
RD(4)	525.26±46.37	446.33±35.77	263.293	818.729	2.948	*0.006****

*,**,*** significant between NKT and KT group at p<0.01

The MVC (µV.), muscle capacity of 4 muscles significantly decreased after treatment in both NKT and KT group (Table 3).

Table 3 Comparison of maximal capacity test (MVC,µV.) before and after treatment in NKT and KT group (mean±SE)

NKT	Before	After	95%CI		*T*	*p*-value
			lower bound	upper bound		
MVC(µV.)						
LT(1)	390.70±39.21	287.16±26.79	209.254	743.433	5.421	*0.000****
RT(2)	367.30±44.37	263.97±20.50	234.187	791.275	3.094	*0.004***
LD(3)	530.90±46.25	374.20±39.38	203.246	834.809	6.024	*0.000****
RD(4)	525.26±46.37	440.56±33.62	238.892	818.729	2.631	*0.013**
KT	Before	After	95%CI		*T*	*p*-value
			lower bound	upper bound		
MVC(µV.)						
LT(1)	303.60±17.82	250.600±15.83	166.886	444.655	4.194	*0.000****
RT(2)	316.93±31.23	231.93±13.97	149.729	602.143	3.635	*0.001****
LD(3)	411.87±27.89	332.53±26.00	212.157	552.509	4.964	*0.000****
RD(4)	446.33±35.77	383.67±29.37	217.585	672.493	3.536	*0.001****

*,**,*** significant between NKT and KT group at $p<0.05$

2) Rest HR, % CVL, NRS, and SWI:

The resting heart rates before treatment of two groups show a comparable level that is 77.73±1.41 (KT) and 79.23±1.29 (NKT) beats per minute. However, the relative cardiovascular load of KT group (7.08 %CVL) at rest is a little bit higher but still in the safe rest value when compared to NKT group (5.79%CVL). The NRS pain scale of KT groups shows lower score (1.63 /10) compared to that of the NKT group (2.57/10). All subjects felt that the KT can relieve pain from work and better than NKT.

The SWI values (Table 4) showed the stress level from work that affected the therapists. Responsibility is estimating as the main issue (8.37±0.2) with a moderate motivation for autonomy and interest in the job.

Table 4 Work stress factors and SWI Score

Group	Total	
	mean	SE
Fatigue	7.27	0.2
Risk	6.33	0.3
Concentration	7.07	0.2
Complexity of the task	6.50	0.3
Work rhythm	6.57	0.3
Responsibility	8.37	0.2
Autonomy	6.80	0.3
Interest in the job	6.93	0.2
SWI	3.57	0.1

4.3 Treatment (During treatment)

Physiological strain during treatment of NKT and KT group shows in Table 5. According to muscle workload (%MVC), muscle strain exceeds the 30% MVC in all muscles for the condition of NKT and KT group. The %MVC of LT, LD, and RD muscles in NKT and KT groups were significantly different except the RT, but all of the muscle work-related load values are over 30% threshold in 'with' KT more over 'without' NKT. The MPF(Hz.), and DMPF(Hz.) in both groups were not significantly different. However, DMPF of both NKT and KT group showed negative values indicating a fatigue in almost all muscles. The cardiovascular load of both groups exceeded the set threshold level (30%CVL). %CVL of KT group is somewhat higher than NKT group ($p<0.001$) (Table 6).

Table 5 Comparison of muscle workload and spectrum analysis during treatment NKT and KT: averages EMG (µV.), %MVC, MPF and DMPF(mean±SE).

EMG	NKT	KT	95%CI		*t*	*p*-value
			lower bound	upper bound		
aEMG(µV.)						
LT(1)	177.73±17.71	191.50±16.70	96.564	309.447	-1.393	0.174
RT(2)	166.83±15.23	180.20±19.05	76.878	311.008	-1.258	0.218
LD(3)	267.03±23.37	276.13±21.92	178.179	415.505	-0.883	0.385
RD(4)	253.36±21.63	241.86±19.26	129.857	429.433	1.379	0.179
%MVC						
LT(1)	49.38±3.98	63.93±4.30	29.720	88.454	-4.352	*0.020**
RT(2)	57.34±3.82	57.50±3.60	39.531	79.405	-0.070	0.945
LD(3)	55.99±4.59	69.01±4.03	31.846	92.101	-3.643	*0.001****
RD(4)	51.63±3.83	59.19±4.78	30.571	89.928	-2.325	*0.027**
MPF(Hz.)						
LT(1)	46.96±1.28	47.36±1.30	38.138	56.701	-0.382	0.705
RT(2)	52.16±1.22	52.96±1.04	44.945	59.413	-0.615	0.543
LD(3)	50.06±1.18	50.56±1.16	42.912	59.035	-0.466	0.645
RD(4)	52.93±0.77	54.30±0.70	48.737	58.374	-1.556	0.131
DMPF(Hz.)						
LT(1)	0.14±0.06	0.00±0.07	-0.488	0.545	1.979	0.057
RT(2)	(-0.06)±0.05	(-0.02)±0.03	-0.287	0.358	-0.767	0.449
LD(3)	(-0.07)±0.07	(-0.06)±0.06	-0.425	0.583	-0.705	0.487
RD(4)	(-0.29)±0.06	(-0.18)±0.03	-0.673	0.050	-1.530	0.137

*,** Significant between NKT and KT group at $p<0.05$

Table 6 Cardiovascular load between NKT and KT technique(mean±SE)

Parameter	NKT	KT	95%CI		*t*	*p*-value
			lower bound	upper bound		
HR(beat/min.) WHR	94.62±1.96	97.78±1.99	83.19	106.48	-3.425	*0.002***
CVL Treatment	38.02±1.73	40.35±1.67	26.81	49.55	-4.617	*0.000****

*,**,*** significant between NKT and KT group at $p<0.01$

4.4 Recovery:

The results of the physiological parameters during 15 minutes recovery show in Table 7. % MVC of 2 groups showed almost the same results except for the LT and RT which are somewhat higher in the KT group. The % MVC are lower than 15% MVC in all muscles during recovery time. The MPF of almost all muscles of KT group is lower than that of NKT group corresponding to the %MVC. The fatigue analysis from DMPF showed a significant positive result in KT group of RT compared to NKT group. The heart rate and %CVL during recovery of KT group were significantly higher than that of NKT group**;** the % CVL value is lower than that of 30%.

Table 7 Compare muscle workload and spectrum analysis at recovery after treatment between NKT and KT in aEMG (µV.), %MVC, MPF, DMPF(mean±SE).

EMG	NKT	KT	95%CI		*t*	p-value
			lower bound	upper bound		
aEMG(µV.)						
LT(1)	9.70±0.37	11.30±0.58	7.710	14.006	-3.813	*0.001****
RT(2)	9.83±0.40	11.26±0.72	7.459	14.517	-2.767	*0.010***
LD(3)	10.33±0.33	10.06±0.58	6.267	14.405	0.465	0.645
RD(4)	10.00±0.31	10.20±0.59	6.343	14.801	-0.344	0.734
%MVC						
LT(1)	3.36±0.31	5.06±0.42	1.492	7.205	-3.409	*0.002***
RT(2)	4.27±0.34	5.33±0.43	2.956	8.153	-2.763	*0.010***
LD(3)	3.50±0.30	3.62±0.38	1.765	6.231	-0.302	0.765
RD(4)	2.72±0.22	3.14±0.33	1.283	5.789	-1.261	0.217
MPF(Hz.)						
LT(1)	41.33±1.53	37.33±1.12	30.882	47.790	3.028	*0.005***
RT(2)	42.96±1.60	36.16±1.25	29.936	50.032	4.156	*0.000****
LD(3)	46.67±0.94	39.36±1.58	30.946	50.453	4.712	*0.000****
RD(4)	42.76±1.16	41.13±0.90	35.619	48.628	1.82	0.079
DMPF(Hz.)						
LT(1)	(-0.51)±0.12	(-0.22)±0.15	-1.238	0.502	-1.611	0.118
RT(2)	(-0.30)±0.13	0.04±0.13	-1.137	0.885	-2.508	*0.018**
LD(3)	(-0.40)±0.39	(-0.57)±0.13	-2.759	2.431	0.464	0.646
RD(4)	(-0.19)±0.19	0.29±0.27	-1.367	2.285	-1.889	0.069

*,**,*** significant between NKT and KT group at $p<0.05$

Table 8 Cardiovascular load between without (NKT) and with Kinesio tape (KT) (mean±SE)

Parameter	NKT	KT	95%CI		*t*	p-value
			lower bound	upper bound		
HR(beat/min.) Recovery HR	77.73±1.42	79.27±1.23	71.41	85.37	-2.935	*0.006***
CVL Recovery	26.70±1.35	27.79±1.40	10.99	35.97	-2.973	*0.006***

*,**,*** significant between NKT and KT group at $p<0.01$

5. Discussion

The physiotherapists have a medium level of experienced work strain found from the perceived SWI score of more than 3.00, and confirmed by the objective measured CVL >30%, a muscular load of >30% MVC (Hägg and Merlin, 2004; Yoopat et al., 2016). In addition, there is a lower muscle capacity of all muscles after the treatment performance of 20 minutes work and 15 minutes rest. The decrease in muscle capacity after treatment is an indication of muscle fatigue (Al-Mulla et al., 2011). The perceived load (SWI) of SWI score more than three is from the high score for responsibility and is not fully compensated by the motivational factors.

The effects of Kinesio-tape to reduce muscle and other physiological strain confirms some benefits in the use of KT and NKT methods:

During treatment, muscle workload of KT groups was higher than that of NKT group ($p<0.05$, $p<0.001$). MPF, DMPF of all muscle showed non-significant differences between KT and NKT group. This result is comfortable with the Magalhães et al. (2015) findings which found that kinescope does not support nor enhance the muscle performance and Csapo et al.(2014) who found that Kinesiotape does not facilitate muscular contraction or may not affect the muscle strength.

During recovery, the MPF of KT showed lower spectral frequency or more fatigue compared to those of NKT group. However, only DMPF of RT in KT group showed a positive or a better recovery from fatigue compared with those of NKT group.

The results of muscles workload showed a %MVC less than 15%MVC during recovery in both NKT and KT group. However, the MVC test value after a recovery period of both groups showed significantly reduced levels. The MVC reduction means that 15 minutes recovery period would not be enough to recover from the induced fatigue due to the therapy in both NKT and KT group.

The result of %MVC and MPF are not always consistent and corresponds neither during treatment nor recovery; this may be possibly due to the large ranges in age and gender of the participating subjects in this study.

The perceived pain scale (NRS) in this study, however, showed that the KT group is lower than that of NKT group and does not fit with the objective measured results. Subjects express their feeling that the Kinesio tapes are helping to reduce the pain level, reduces invisible load, and relax during the patient treatment. In this study, KT may give a psychological support to rehabilitation staff. This finding corresponds with the study of Karatas (2011) who stated that Kinesio tape could help user decrease pain, moving the load and favorable relaxation. Furthermore, physiotherapists feel more safe and satisfied when applying Kinesio tape. Yu Wen Chao (2016) also reported a decrease of pain level at the trigger points of the Upper Trapezius and Deltoid muscles when applying Kinesio tape.

From this study, the conclusion is that physiotherapists have a moderate work strain level. The Kinesio Tapes do not help to reduce the treatment strain significantly. Other studies seem to confirm our findings that "the Kinesio Tapes may partially compensate some proprioceptive deficits induced by muscle fatigue" (Zanca et al., 2015). Morris et al.(2013) and Williams et al.(2012) but that Kinesio Tape shows little evidence of effectiveness and has a less positive impact on the therapists work strain.

6. Conclusion & Recommendation

The Kinesio Tape technique does not affect the physiological response in the shoulder region during a repetitive treatment for the rehabilitation personal positively. Furthermore, the physiotherapists in these project settings are exposing to a moderate risk for MSDs, and that a 15 minutes resting period is too short to restore fully from their muscles effort, which may lead to fatigue in other treatment settings. However, the fact that there is a large variety of various types and shapes of Kinesio-Tapes is their impact on therapists should reconsider in future projects. The experimental setting should consider organizing in other work-rest schemes, other treatment settings, on a larger sample size, other comparable treatment methods, differences in gender, age groups, therapeutic experiences, and on a larger sample of therapists and a wider variety of patients.

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8. References

Al-Mulla, M. R., Sepulveda, F., & Colley, M. (2011). A review of non-invasive techniques to detect and predict localised muscle fatigue. *Sensors, 11*(4), 3545-3594.

Birgit Kumbrink. (2012). K taping:An Illustrated guide, Springer-Verlay Berlin Heidelberg New York: ISBN-13-978-3-642-12931-5

Chao, Y. W., Lin, J. J., Yang, J. L., & Wang, W. T. J. (2016). Kinesio taping and manual pressure release: Short-term effects in subjects with myofasical trigger point. *Journal of Hand Therapy, 29*(1), 23-29.

Csapo, R., & Alegre, L. M. (2014). Effects of Kinesio® taping on skeletal muscle strength-A meta-analysis of current evidence, *Journal of Science and Medicine in Sport, 18*(4), 450-456.

De Luca, C. J. (1997). The use of surface electromyography in biomechanics. *Journal of applied biomechanics, 13*(2), 135-163.

Farrar, J. T., Young, J. P., LaMoreaux, L., Werth, J. L., & Poole, R. M. (2001). Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain*, *94*(2), 149-158.

Fu, T. C., Wong, A. M., Pei, Y. C., Wu, K. P., Chou, S. W., & Lin, Y. C. (2008). Effect of Kinesio taping on muscle strength in athletes—a pilot study. *Journal of science and medicine in sport*, *11*(2), 198-201.

García-Muro, F., Rodríguez-Fernández, Á. L., & Herrero-de-Lucas, A. (2010). Treatment of myofascial pain in the shoulder with Kinesio taping. *A case report. Manual therapy*, *15*(3), 292-295.

Hägg, G. M., & Melin, B. (2004). Muscle fatigue. In: Merletti, R., Parker, P.J.(Eds.), Electromyography, physiology, engineering and non-invasive applications. *IEEE series in Biomedical engineering*, chapt. 9.3 Wiley-IEEE Press.ISBN 978-0-0471-675808-8

Halski, T., Ptaszkowski, K., Słupska, L., Paprocka-Borowicz, M., Dymarek, R., Taradaj, J., ... & Rosińczuk, J. (2015). Short-term effects of kinesio taping and cross taping application in the treatment of latent upper trapezius trigger points: a prospective, single-blind, randomized, sham-controlled trial. *Evidence-Based Complementary and Alternative Medicine*, 2015.

Kang, M. H., Choi, S. H., & Oh, J. S. (2013). Postural taping applied to the low back influences kinematics and EMG activity during patient transfer in physical therapists with chronic low back pain. *Journal of Electromyography and Kinesiology*, *23*(4), 787-793.

Kaya, E., Zinnuroglu, M., & Tugcu, I. (2011). Kinesio taping compared to physical therapy modalities for the treatment of shoulder impingement syndrome. *Clinical rheumatology*, *30*(2), 201-207.

Kenzo Kase, Jim Wallis, Tsuyoshi Kase. (2003). Clinical Therapeutic application of the Kinesio taping methods. 2nd Edition. ISBN 097690842,9780976960543

Kenzo Kase. (2003). Illustrated Kinesio Taping. 4th Edition.Tokyo. KE'I KAI Information. ISBN1-880047-24-1

Kromer, H., & Grandjean E. (2000). Stability and change in genetic and environmental influences on handgrip strength in old male twins, *Journal Applied Physiology 89*(5), 1979-1883

Maton, T. (2014). Prevention and Control of Chronic Non-communicable Diseases & Related research, ISBN:978-188-752-136-9

Morris, D., Jones, D., Ryan, H., & Ryan, C. G. (2013). The clinical effects of Kinesio® Tex taping: A systematic review. *Physiotherapy theory and practice*, *29*(4), 259-270.

Mostafavifar, M., Wertz, J., & Borchers, J. (2012). A systematic review of the effectiveness of kinesio taping for musculoskeletal injury. *The Physician and sportsmedicine*, *40*(4), 33-40.

Nordin, N. A. M., Leonard, J. H., & Thye, N. C. (2011). Work-related injuries among physiotherapists in public hospitals: a Southeast Asian picture. *Clinics*, *66*(3), 373-378.

Obembe, A., Onigbinde, A., Johnson, O., Emechete, A., & Oyinlola, M. (2009). Occupational injuries among physical therapists in South-West, Nigeria. *Nigerian Journal of Medical Rehabilitation*, *13*(1 and 2), 25-30.

Pyszora, A., Wójcik, A., & Krajnik, M. (2010). Are soft tissue therapies and Kinesio Taping useful for symptom management in palliative care? Three case reports. *Advances in Palliative Medicine*, *9(3)*, 87-92.

Şimşek, H. H., Balki, S., Keklik, S. S., Öztürk, H., & Elden, H. (2012). Does Kinesio taping in addition to exercise therapy improve the outcomes in subacromial impingement syndrome? A randomized, double-blind, controlled clinical trial. *Acta orthopaedica et traumatologica turcica*, *47*(2), 104-110.

Vanwonterghem K., Verboven, J. and M. Cloostermans. (1985). Subjective Workload Index, *Tijdschrift Ergonomie*, *10*(3), 10-14. (in Dutch).

Vanwonterghem K., Yoopat, P., Maes. (2012). Musculoskeletal Disorders a new approach. *Work a Journal of Prevention, assessment and rehabilitation, 41*, 2293 - 2298

Williams, S., Whatman, C., Hume, P. A., & Sheerin, K. (2012). Kinesio taping in treatment and prevention of sports injuries. *Sports medicine*, *42*(2), 153-164.

Wu, W. T., Hong, C. Z., & Chou, L. W. (2015). The Kinesio Taping method for myofascial pain control. *Evidence-Based Complementary and Alternative Medicine*, 2015.

Wang, Y. H., Chen, S. M., Chen, J. T., Yen, W. C., Kuan, T. S., & Hong, C. Z. (2008). The effect of taping therapy on patients with Myofascial pain syndrome: a pilot study. *Taiwan Journal of Physical Medicine and Rehabilitation*, *36*(3), 145-150.

Zanca, G. G., Mattiello, S. M., & Karduna, A. R. (2015). Kinesio taping of the deltoid does not reduce fatigue induced deficits in shoulder joint position sense. *Clinical Biomechanics*, *30*(9), 903-907.