วารสาร
เทคนิคการแพทย์และกายภาพบำบัด
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นิพนธ์ต้นฉบับ
ORIGINAL ARTICLE

ผลของการใช้เทปยืดหยุ่นและการออกกำลังกายกล้ามเนื้อแกนกลางลำตัวต่อระดับความเจ็บปวด ระดับพร่องความสามารถและความยืดหยุ่นของเอวในผู้ป่วยอาการปวดหลังส่วนล่างชนิดไม่จำเพาะเจาะจง: การศึกษาเชิงทดลองชนิดมีการสุ่ม

ขิ่นนานโอมานวิน[1], มายโอตูซาขิ่น[2] และ ยอดชาย บุญประกอบ[3*]

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บทคัดย่อ

การติดเทปยืดหยุ่นเป็นวิธีหนึ่งที่นิยมใช้ในการรักษาการบาดเจ็บทางกีฬาและผู้ป่วยระบบกล้ามเนื้อและกระดูก อย่างไรก็ตาม ผลการรักษาผู้ป่วยอาการปวดหลังส่วนล่างชนิดไม่จำเพาะเจาะจงในระยะกึ่งเฉียบพลันด้วยการติดเทปยืดหยุ่นยังไม่มีหลักฐานการศึกษายืนยันผลที่ชัดเจน การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อประเมินผลการรักษารวมระหว่างการติดเทปยืดหยุ่นกับการรักษาแนวอนุรักษ์ต่อระดับอาการปวด ระดับพร่องความสามารถและความยืดหยุ่นของเอว โดยเป็นการศึกษาเชิงทดลองชนิดมีการสุ่ม กระทำในอาสาสมัครที่เป็นผู้ป่วยอาการปวดหลังส่วนล่างชนิดไม่จำเพาะเจาะจงในระยะกึ่งเฉียบพลัน (6-12 สัปดาห์) จำนวน 84 คน เป็นเพศชาย 36 คนและเพศหญิง 48 คน อาสาสมัครในกลุ่มควบคุมได้รับการรักษาชนิดอนุรักษ์นิยมคือได้รับคลื่นเหนือเสียงและการออกกำลังกายกล้ามเนื้อแกนกลางลำตัว ส่วนกลุ่มทดลองได้รับการรักษาด้วยคลื่นเหนือเสียงและเทปยืดหยุ่น โดยทั้งสองกลุ่มได้รับการรักษาสัปดาห์ละ 3 ครั้งเป็นระยะเวลา 2 สัปดาห์ ตัวแปรที่ใช้ในการประเมินได้แก่ visual analog scale (VAS) เพื่อประเมินการเปลี่ยนแปลงระดับความเจ็บปวด ดัชนี OsWestry disability เพื่อประเมินการเปลี่ยนแปลงความพร่องความสามารถในการทำหน้าที่และการทดสอบโชเบอร์ชนิดดัดแปลงเพื่อประเมินความยืดหยุ่นของบริเวณเอว ผลการศึกษาพบว่าเมื่อเปรียบเทียบภายในกลุ่มระดับอาการปวด และความพร่องความสามารถลดลงอย่างมีนัยสำคัญทางสถิติ รวมถึงความยืดหยุ่นบริเวณเอวเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ($p < 0.001$) ที่สัปดาห์ที่สองและสัปดาห์ที่สี่ ในขณะที่การเปรียบเทียบระหว่างกลุ่มพบว่ากลุ่มทดลองมีการลดลงของระดับอาการปวดและความพร่องความสามารถอย่างมีนัยสำคัญทางสถิติ รวมถึงการเพิ่มขึ้นของความยืดหยุ่นของหลังอย่างมีนัยสำคัญทางสถิติเฉพาะในสัปดาห์ที่สี่เท่านั้น ($p < 0.001$) สรุปผลการศึกษา การรักษาด้วยเทปยืดหยุ่นกับคลื่นเหนือเสียงมีประสิทธิภาพในการรักษาได้คล้ายคลึงกับคลื่นเหนือเสียงกับการออกกำลังกายกล้ามเนื้อแกนกลางลำตัวในผู้ป่วยปวดหลังส่วนล่างชนิดไม่จำเพาะเจาะจง

คำสำคัญ: ปวดหลังส่วนล่างแบบไม่เจาะจง ผ้ายืด การออกกำลังกายกล้ามเนื้อแกนกลางลำตัว คลื่นเหนือเสียง

[1] ภาควิชาวิทยาศาสตร์การกีฬาและการออกกำลังกาย บัณฑิตวิทยาลัย มหาวิทยาลัยขอนแก่น ประเทศไทย
[2] ภาควิชาสรีรวิทยา มหาวิทยาลัยเทคโนโลยีการแพทย์ ย่างกุ้ง ประเทศเมียนมาร์
[3]สายวิชากายภาพบำบัด คณะเทคนิคการแพทย์ มหาวิทยาลัยขอนแก่น ประเทศไทย
*ผู้รับผิดชอบบทความ

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ORIGINAL ARTICLE

The effects of elastic taping and core stability exercises on pain intensity, disability level and lumbar flexibility in sub-acute non-specific low back pain : a randomized controlled trial

Khin Nan Ohnmar Win[1], Myo Thuzar Khin[2] and Yodchai Boonprakob[3*]

Abstract

Elastic taping (ET) is widely used in sport injuries and patients with musculoskeletal problems, however, the effect of ET is not very clear in patient with sub-acute non-specific low back pain (NSLBP). The objective of this study was to investigate the combined effect of ET to conventional treatments on pain intensity (PI), disability level (DL) and lumbar flexibility (LF). This study was a randomized controlled clinical trial. Eighty four (36 males and 48 females) patients with sub-acute NSLBP were recruited and were divided into 2 groups. The control group, patients were treated by ultrasound and core stabilizing exercise (CSE), whereas patient of the intervention group were treated by ultrasound and ET. Both groups were treated three times per week within 2 weeks. Visual Analog Scale (VAS) was used for measuring pain intensity. Oswestry Disability Index (ODI) was used for determining functional disability. Modified Schober's Test (MST) was also used for measuring lumbar flexibility. The results demonstrated that there are significant pain reduction and reducing disability and significant improving in lumbar flexibility in both groups when compared the baseline with the second week and with the fourth week ($p < 0.001$). There are showed better improvement in the intervention group, but there are also significant relief of pain and decreasing disability and increasing in lumbar flexibility between groups after intervention and at the fourth week ($p < 0.001$). In conclusion, ET and US or US and CSE had therapeutic effects similarly for treating patients with sub-acute NSLBP.

Keywords: Non-specific low back pain, Elastic taping, Core stability exercises, Ultrasound

[1] Department of exercise and sport sciences, Graduate school, Khon Kaen University, Thailand 40002

[2] Department of Physiotherapy, University of Medical Technology, Yangon

[3] Department of physical therapy, Faculty of Associated Medical science, Khon Kaen University, Thailand 40002

*Corresponding Author: (e-mail: yodchai@kku.ac.th)

Introduction

Low back pain, one of the major health problems around the world, is a musculoskeletal concern[1]. It is described as pain, stiffness and muscle tension on the place under the costal cage to inferior gluteal fold, with or without sciatica (leg pain)[2]. 60-80% of adults are experiencing low back pain in their lives time with high incidence and prevalence relatively[3]. Almost 85% of low back pain is considered as non-specific cases because of its unknown origin or pathoanatomical causes[4]. NSLBP is defined as low back pain (LBP) not attributable to a recognizable, without known specific pathology (eg, infection, tumor, osteoporosis, lumbar spine fracture, inflammatory disorder, structural deformity, radicular syndrome, or cauda equina syndrome)[5]. Identification of "red flags" is used as indicator and if the patients have no "red flags" signs, it is considered as non-specific low back pain[2].

In back pain management, pharmacological and non-pharmacological treatments are widely used6. Although these treatments are in hand, pain does not heal within 6 months. In most people, the pain and associated disabilities persist for months; however, only a small proportion remains severely disabled. For those whose pain does not resolve completely, recurrence during the next year is very common[2]. Therefore, clinicians become sought different types of treatments for low back pain and elastic taping become potential treatment as it improves pain in musculoskeletal problems[7].

As the elastic taping is a new trend of management for the musculoskeletal problems with its improving adjunctive effect to the conventional therapy[8] and it either has immediate improvement on pain and disability or substantial improvement on functional endurance only after first week of application[9], we interested to study its pain improving for immediate and substantial effects on low back pain. In the previous time, elastic taping was used mainly for acute musculoskeletal problems as in use of sport medicine[10]. But, nowadays, it's usage in pain management is very popular because most of the patients reported that they satisfied to receive elastic taping as a conjunctive treatment with other treatments or elastic taping alone[11].

As the main problems of non-specific low back pain are pain and disability[2], we interested the possible effects of elastic taping on pain and disability caused by low back pain. The VAS is a ruler, usually contains 10 cm and anchored by two ends of: no pain on the left end and worst pain that can be imaginable on the right end[12]. VAS is reliable to use to assess pain intensity in acute stage as well as for accessing the pain intensity of chronic stage [13,14]. Oswerstry Disability Index (ODI) or Oswestry LBP Disability Questionnaire is one of the most common useful outcome measurements for LBP in the clinical setting. ODI is a principal-tools that measure condition-specific outcome and widely used in the assessment of spinal disorders. It is a vigorous and valid measurement tool and becomes worldwide outcome measurement. It is a good specific outcome measurement in the subjects with LBP[15]. Modified Schober's Test (MST) is widely used as a universal test for measuring lumbar movements in the sagittal plane. It is mainly used to test the lumbar flexibility in back pain and other lumbar problems like ankylosing spondylitis (AS). It has been modified from the original Schober's test by

Macrae and Wright in order to observe the significant difference in the skin movement respective to the spinous process under it[16]. There are other tests like goniometry and inclinometer, etc. Among them, MST is widely used to evaluate function of lumbar spine. It has been mentioned that MST is highly reliable for measuring lumbar ROM[17]. On the other hand, core stability exercises (CSE) are very good at reducing pain and disability in back pain for the short term[18]. As the core muscles give stability to proximal part and mobility to distal part, it is the most appropriate intervention to treat non-specific low back pain[19]. Core stability exercises are widely used in Myanmar for treating low back pain in clinical setting. As the elastic taping alone cannot give long term pain improving, reducing the recurrence and there was no study which combined core stability exercises with the elastic taping for improving symptoms of low back pain. In this study, therefore, we studied the short-term effect of elastic taping combined with core stability exercises in sub-acute non-specific low back pain. We hypothesized that a combined treatment should be given better effect than one treatment in these patients.

Material and Methods

Design and setting

This study was a randomized controlled trial, a single blinded, assessor blinding with intention to treat analysis and it was conducted at the Department of Physical Medicine and Rehabilitation, North Okkalapa General Hospital (NOGH) and Yangon Orthopedic Hospital (YOH), Yangon, Lower Myanmar. I collected data from June 2018 and finished it at the end of February 2019 after receiving ethical approval from Khon Kaen University and approval from Institutional Review Board of University of Medical Technology.

Participants

The sample size was calculated using pain intensity of VAS score in the previous study that measured the effectiveness of elastic taping for 59 subjects with chronic non-specific low back pain, the intervention group (IG) = 30 persons or and the control group, (CG) = 29 persons[9]. The average mean of post-test VAS score for the intervention group (μ_{trt}) = 4.7 with the standard deviation of (σ_{trt}) =1.4 and the average mean of post-test VAS score in the control (sham taping) group (μ_{con}) = 5.6 with the standard deviation (σ_{con}) =1.4. Ratio (control/treatment) = (r) = 1, significance level = alpha (α) = 0.05 ($z_{1-\alpha/2} = z_{(0.975)}$ = 1.959964) and a type II error probability = beta (β) = 0.20, ($z_{1-\beta} = z_{(0.80)}$ = 0.8416212) and $\Delta = \mu_{trt} - \mu_{con}$ = 4.7 – 5.6 = -0.9 (Δ^2=0.81) were used to calculate the sample size as follow:

$$n_{trt} = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 \left[\delta^2_{trt} + \frac{\delta^2_{con}}{r}\right]}{\Delta^2}$$

$$n_{trt} = \frac{(1.959964 + 0.8416212)^2 \left[(1.4)^2 + \frac{(1.4)^2}{1}\right]}{0.81}$$

$$= \frac{(7.8488796329)(3.92)}{0.81}$$

$$= \frac{30.7676081608}{0.81}$$

$$= 37.9847 \sim 38$$

$$= 42 \text{ (with 10\% drop out)}$$

Therefore, a total of 84 persons were chosen for this study.

Eighty-four participants, 30-59yrs, both sexes, with sub-acute (6 weeks to 12 weeks) non-specific back pain (SNSLBP) with or without leg pain who voluntarily participated were recruited into two groups by computerized randomization of balanced allocation in the intervention group (IG) and the control group (CG) for 14 blocks using Win Pepi software and each block consisted of 6 participants. They complained pain more than 3 times per week with or without previous history of low back pain. Pregnant patients, patients who has malignancy, history of surgery to lumbar spine, red flags sign (eg. cancer, major trauma, bladder and bowel dysfunction) and/or allergy to elastic taping were not included in this study.

Procedure

A total of 586 patients were selected from the North Okkalapa General Hospital (NOGH) and Yangon Orthopedic Hospital (YOH). The data was collected from June 2018 to February 2019. The participants were examined by the rehabilitation medicine physician, then they were screened by their pain level. All the patients whose pain were 57- (moderate pain intensity) on Visual Analog Scale (VAS) were selected in this study. Before participating in this study, the patients signed informed consent form. All the participants were assessed at the baseline by using Visual Analog Scale (VAS), Oswestry Disability Index (ODI) and Modified Schober's Test (MST) after allocating into two groups by computerized blocked allocation, 42 participants in each group. The participants in the intervention group have been tested for allergy to ET (applied piece of ET to the participant's skin and let it on skin for 30 mins and checked the area for allergy such as redness, itching, etc.). They received ultrasound therapy (US), core stability exercises (CSE) and elastic taping (ET). The participants in the control group received ultrasound therapy (US) and core stability exercises (CSE) (Figure 3).

Taping application

In this study, Helio Olympia Kinesiology tape rolls were used. The place to apply ET was shaved (if needed) and cleaned with alcohol. Participant was sitting on the chair with feet supported fully and bending forward as much as he/she could. The tape was applied to the site of pain by four I-bands technique with 25%-30% of maximal stretch, the first band was horizontally, the second band was vertically and the third and fourth were crossed to get the star shape. The tape remained in place for 2 days and applied 6 times during total two weeks of intervention.

Ultrasound Therapy

In this study, Metron Accusonic Plus Ultrasound Therapy Unit, Model AP 100 from Metron Medical Australia Pty Ltd, Austria was used and (US) therapy was given to the site of the pain with frequency 1 MHz and intensity 1 W/cm^2 for 5 mins in circular motion in prone lying position to all (84) participants.

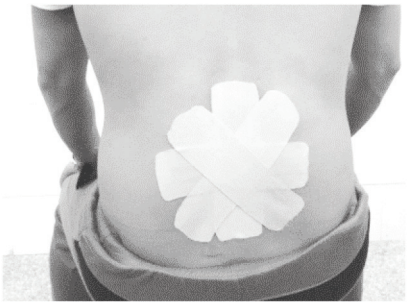

Figure 1 Application of elastic taping for participants from intervention group

Figure 2 The use of ultrasound therapy on the site of pain

Core stability exercises

CSE training included pelvic tilt, bridging with knee extension, trunk curl (Crunch), double legs abdominal press, cat and camel (back raise), quadrated arm/leg raise, and arm/leg raise exercises. Each exercise had to performed with 5 repetitions after receiving US therapy. All the exercises must be performed under careful supervision and must be recorded in participant's record form[20].

Ultrasound therapy and core stability exercises were given by the physiotherapist from the hospital who was assigned as one of research assistants for this study and elastic taping was performed by the principal investigator. The treatments were given 3 times per week for two weeks and participants performed CSE 5 days per week for two weeks. Pain intensity (PI), disability level (DL) and lumbar flexibility (LF) were assessed at the baseline, after all the treatment (second weeks), and at the fourth week again at follow up session to know the retention effects and compared within group and between groups.

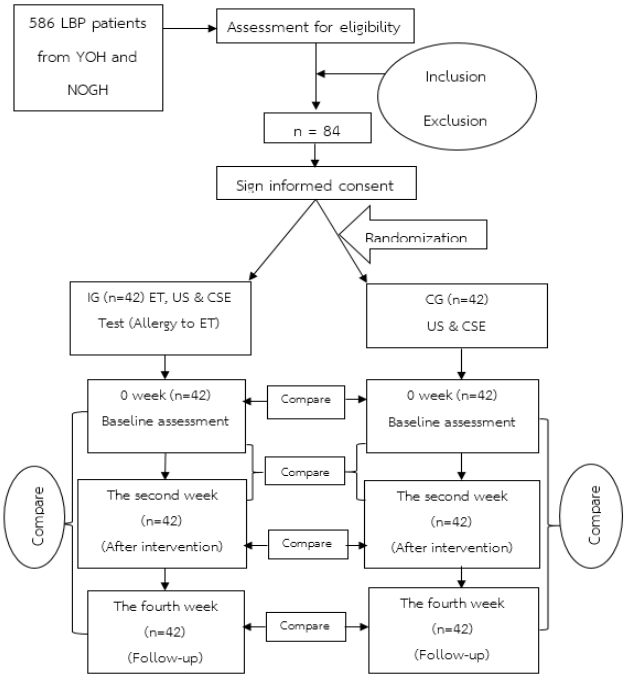

Figure 3 Flow chart of the study (PI: Pain Intensity; DL: Disability Level; LF: Lumbar Flexibility; IG: Intervention Group; CG: Control Group)

Statistical analysis

The data were analyzed by Stata MP 15.1. The descriptive statistics were presented as frequency and percentage for categorical variable and as summary statistics such as mean (SD) for continuous variable. The data distribution was assessed by Kolmogorov-Smirnov normality test. I used Mauchly's test for sphericity to test homogeneity of variance. If data passed this test, sphericity was assumed; however, if data failed this test, Greenhouse-Geisser modification was applied. A two-way mixed model analysis of variance (ANOVA) was performed to detect differences for the outcome measures with groups (the intervention and the control groups) and time (at baseline, the 2nd week and the 4th week follow-up) as the independent variables. When a

significant group into time interaction effect was detected, independent t-tests were performed to determine magnitude of mean differences between groups at each time point period. One-way repeated measure ANOVA was performed to find out differences for VAS, ODI and MST as the repeated measures at baseline, the 2nd week and the 4th week follow-up. Furthermore, if there was a significant time effect, dependent t-test was used to compare mean magnitude of each time with baseline. All test statistics were two-sided and considered as statistically significant for a *p*-value of less than 0.05.

Results

All the baseline demographic and clinical characteristics of the participants in both groups were very similar in this study. Some data were tested by statistical analysis, for example VAS, ODI, and MST which did not show a significant difference **(Table1).**

One-way repeated measures analysis of variance (one-way ANOVA) was run to determine if there were differences in pain intensity measure (VAS), disability level measure (ODI) and lumbar flexibility measure (MST) between baseline and follow-up periods for each group and the results revealed that there were statistically significant differences in mean VAS ($F_{(2, 82)} = 211.55$, $p < 0.001$ in the intervention group and $F_{(2, 82)} = 84.64$, $p < 0.001$ in the control group), mean ODI ($F_{(2, 82)} = 122.26$, $p < 0.001$ in the intervention group and $F_{(2, 82)} = 55.49$, $p < 0.001$ in the control group) and mean MST ($F_{(2, 82)} = 122.26$, $p < 0.001$ in the intervention group and $F_{(2, 82)} = 29.89$, $p < 0.001$ in the control group) in both groups. Pair-wise comparisons using Bonferroni recorded that both groups have significant reduction in pain intensity, disability level and increasing in lumbar flexibility from baseline to each follow-up period **(Table 2).**

Two-ways mixed analysis of variance (two-ways mixed ANOVA) mentioned a statistically significant group and visit (time factor) interaction effect on pain intensity ($F_{(2, 164)} = 37.07$; $p < 0.001$), functional disability ($F_{(2, 164)} = 23.1$; $p < 0.001$) and lumbar flexibility ($F_{(2, 164)} = 29.6$; $p < 0.001$). It was found out that the statistically significant reduction in VAS, functional disability measure (ODI) and lumbar flexibility measure (MST) in treatment group than in control group, at both second week and fourth week while conducting multiple comparisons between intervention and control groups at each time point using independent t-test.

The mean differences in pain intensity between the intervention and control groups were: 1.8 (95% CI: 1.2 to 2.4; $p < 0.001$) at second week of intervention and 2.2 (95% CI: 1.6 to 2.8; $p < 0.001$) for fourth week of intervention , the mean differences in functional disability between the intervention and the control groups were: 11.6 (95% CI: 7.1 to 15.9; $p < 0.001$) at second week of intervention and 15.0 (95% CI: 10.3 to 19.7; $p < 0.001$) for fourth week (follow-up) and mean differences in lumbar flexibility between the intervention and control groups were: 1.4 (95% CI: 0.9 to 1.9; $p < 0.001$) at second week of

Discussion

In this study, pain intensity at rest was the primary outcome. Other outcomes were functional disability and lumbar flexibility. The results in this study provided statistically significant reduction in

pain intensity at rest (VAS), functional disability (ODI) and lumbar flexibility (MST) in both groups when compared the baseline with the second week and compared the baseline with the fourth week. However, there were significant pain reduction, disability reducing and improving lumbar intervention and 1.9 (95% CI: 1.4 to 2.5; $p < 0.001$) at fourth week (follow-up) **(Table 3)**. flexibility in both groups, after two weeks of intervention, but the results showed statistically significant differences in the intervention group when compared with the control group immediately after the intervention and at the fourth week or follow up assessment.

Table 1 Baseline demographic and clinical characteristics of the participants

Characteristics	Intervention group (n=42)	Control group (n=42)
Age (years), mean ±SD	41.2±8.8	42.3±8.1
Gender, n (%)		
Male	17 (40.5)	19 (45.2)
Female	25 (60.0)	23 (54.8)
BMI (kg/m2), mean ±SD	23.9±3.1	23.8±2.9
Education, n (%)		
Illiterate	2 (4.8)	3 (7.1)
Primary School	9 (21.4)	7 (16.7)
Middle School	7 (16.7)	8 (19.1)
High School	12 (28.6)	10 (23.8)
Above High School	12 (28.6)	14 (33.3)
Occupation, n (%)		
Sedentary	27 (64.3)	24 (57.1)
Manual	15 (35.7)	18 (42.9)
Marital Status, n (%)		
Single	18 (42.9)	13 (31.0)
Married	24 (57.1)	29 (69.1)
Previous History of LBP, n (%)		
Negative	18 (42.9)	21 (50.00)
Positive	24 (57.1)	21 (50.00)
Sciatica, n (%)		
Negative	27 (64.3)	34 (81.0)
Positive	15 (35.7)	8 (19.1)
VAS, mean ±SD	5.9±0.8	5.8±0.9
ODI, mean ±SD	46.8±15.1	45.4±15.5
MST, mean ±SD	2.5±1.5	2.6±1.4

Table 2 Differences in pain intensity on Visual Analog Scale (VAS), disability level on Oswestry Disability Index (ODI) and lumbar flexibility on Modified Schober's Test (MST) of sub-acute non-specific low back pain patient's baseline, the second week and the fourth week (follow-up) by the intervention and the control groups

Outcome Measure	Group	Period of intervention	Bonferroni	
			Means difference (95% CI)	*p-value*
Visual Analog Scale (VAS)	The intervention group	Week 0 vs 2	4.4 (3.8, 5.0)	**<0.001**
		Week 0 vs 4	4.7 (4.1, 5.4)	**<0.001**
	The control group	Week 0 vs 2	2.5 (1.9, 3.2)	**<0.001**
		Week 0 vs 4	2.5 (1.8, 3.2)	**<0.001**
Oswestry Disability Index (ODI)	The intervention group	Week 0 vs 2	32.1 (26.0, 38.2)	**<0.001**
		Week 0 vs 4	35.5 (29.4, 41.6)	**<0.001**
	The control group	Week 0 vs 2	19.1 (12.2, 26.0)	**<0.001**
		Week 0 vs 4	19.0 (12.1, 26.0)	**<0.001**
Modified Schober's Test	The intervention group	Week 2 vs 0	-3.0 (-3.6, -2.3)	**<0.001**
		Week 4 vs 0	-3.3 (-4.0, -2.7)	**<0.001**
	The control group	Week 2 vs 0	-1.4 (-2.2, -0.7)	**<0.001**
		Week 4 vs 0	-1.3 (-2.0, -0.6)	**<0.001**

The minimally clinically important change (MCIC) for pain intensity of sub-acute non-specific low back pain (SNSLBP) and chronic non-specific low back pain (CNSLBP) is at least 20mm on 100mm VAS[21]. In our study, pain intensity on VAS cores were 5.9 at the baseline, 1.5 at the second week (immediately after intervention) and 1.1 at the fourth week (follow-up) in the intervention group. In previous study, researchers reported that MCIC for ODI was score of more than or equal to 10 points in all types of LBP[22]. In our study, ODI score which represent functional disability were 46.8 at the baseline, 14.7 at the second week (immediately after intervention) and 11.3 at the fourth week (follow-up) in the intervention group. There is overall improving in lumbar flexibility seen in the intervention group. It means that our results reflect both statistically significant change and MCIC when we compared the baseline with the second week and the baseline with the fourth week.

Although, nowadays, the ET methods are becoming very popular, the background mechanism of the effects of ET in treating musculoskeletal problems are still unclear[23]. There were some previous studies about ET focused on pain of Achilles' tendon, shoulders, knees, acute low back pain (ALBP) and chronic low back pain (CLBP). The reviews were consistently concluded that there was no great

quality evidence of the use of ET in management of musculoskeletal problems despite the short-term pain reduction effect of ET. They mostly focused on CLBP and its related conditions[23-25]. researchers studied about the effect of ET in CLBP and reported that ET could alleviate pain and normalize muscle function[26].

Table 3 Differences in pain intensity on Visual Analog Scale (VAS), disability level on Oswestry Disability Index (ODI) and lumbar flexibility on Modified Schober's Test (MST) of sub-acute non-specific low back pain patients between the intervention and the control groups at each visit

Outcome measure	Period of intervention	Group	Mean ± SD	Independent t-test		
				Mean difference (95% CI)	t -statistic	*p-value*
Visual Analog Scale (VAS)	0 week	Intervention	5.8 ±0.8	-0.02 (-0.4, 0.3)	-0.1	0.894
		Control	5.9 ±0.9			
	The second week	Intervention	1.5 ±1.3	1.8 (1.2, 2.4)	6.0	**<0.001**
		Control	3.3 ±1.4			
	The fourth week	Intervention	1.1 ±1.0	2.2 (1.6, 2.8)	7.3	**<0.001**
		Control	3.3 ±1.5			
Oswestry Disability Index (ODI)	0 week	Intervention	46.8±15.1	1.5 (-5.2, 8.1)	0.4	0.664
		Control	45.3±15.5			
	The second week	Intervention	14.7±8.8	11.6 (7.1, 15.9)	5.2	**<0.001**
		Control	26.3±11.4			
	The fourth week	Intervention	11.3 ±9.5	15.0 (10.3,19.7)	6.3	**<0.001**
		Control	26.3±11.9			
Modified Schober's Test (MST)	0 week	Intervention	2.5 ±1.5	0.1 (-0.5, 0.7)	0.3	0.767
		Control	2.6 ±1.4			
	The second week	Intervention	5.5 ±1.2	1.4 (0.9, 1.9)	5.3	**<0.001**
		Control	4.0 ±1.2			
	The fourth week	Intervention	5.8 ±1.1	1.9 (1.4, 2.5)	7.1	**<0.001**
		Control	3.9 ±1.4			

In previous study, the researcher compared the effectiveness of ET and placebo taping in 60 patients with CLBP and reported significant immediate pain reduction in the ET group at the end of the first week, but there was no significant difference at the fourth week[9]. This study was similar method with our study but different results that they could only reported immediate improvement in pain intensity because the researcher applied ET only one time and let the tape in place for 7 days. This short intervention, one week of ET engendered confidence and greater awareness to remain active[23]. It should emphasize the effects of pain and functional disability reduction of ET in musculoskeletal concerns. Besides, Kelle and co-workers compared ET with minimal care in 109 patients with acute non-specific low back pain (ANSLBP). They also reported that ET provided the immediate pain reduction in ANSLBP, even it was not a statistically significant difference between groups but overall pain reduction was seen in ET group. They also suggested that ET can be used as a complementary method of treatment in ANSLBP. Their technique of applying ET was quite similar with the technique in our study, but they applied only three times and the tape remained four days in place to be treated. They reported overall pain reduction and decreasing functional disability earlier in ET group than the minimal care group[27].

The period that the tape can remain in place briefly depends upon the body site to be applied. For example, the time must be shorter when applying on extreme mobile parts such as knee and elbow, in the lumbar area, the time may be 3-4 days, after that the ends of the tape become curl because of the friction of clothing[27]. In our study, we applied ET six times throughout two weeks of intervention period and the tape was remained two days in place per one application to wipe out the possible effects of allergic reaction by hot weather, dust and sweating. If the elastic tape is too stretched out, there will lead to reduce or change its effect, so it is superb to use less tension rather than too excessive tension during application[26,28]. The ET method used in this study is very appropriate for the pain reduction with 25%-30% of stretch.

As the pain intensity directly relates to the physical disability and so, when the pain increased, functional disability also increased. Pain was both clinically and statistically significant decreased after the intervention and so, functional disability also significantly reduced. As the pain intensity and functional disability are reversely related to the lumbar flexibility and so, when the pain and functional disability increased, lumbar flexibility decreased. Pain was both clinically and statistically significant decreased after the intervention and so lumbar flexibility was significantly improved.

The possible mechanism of pain reduction by ET is an improvement of intramuscular blood flow and it helps to promote the proprioceptive and nociceptive stimulation at the selected region[29]. The technique used in the current study covered space correction technique, using light to moderate tension (15-50%) of maximum stretch which gives increased space on the area of the pain and inflammation. This increased space is believed in reducing pressure by lifting the skin directly under the tape. Then, it is very essential to alleviate pain as the elastic quality of the tape helps to lift fascia and soft tissues lead to creating

more space and resulting decreased pressure over the injured tissues. ET decreased the pressure under the area of the strip which act as channel to direct the waste products and exudates to nearest lymph ducts. It also increases circulation, assists in the reduction of pain and removal of fluid. This is also helpful for the lumbar stability[30]. So, ET also provides optimal support to the muscles, correct and maintain the alignment, remove fluid congestion and actuate the endogenous analgesic system[31,32]. According to some previous studies, it was suggested that the ET stimulates the autonomic nervous system contributing to vasodilation of blood vessels in the taping area resulting in increased blood circulation. Improved blood circulation can supply much oxygen to the muscles[33,34]. Therefore, ET improve the resistance to pain and fatigue for the extensor muscles of lumbar spine and lead to achieve the significant pain reduction on VAS in SNSLBP[35]. The results of the current study pointed out combining ET to the conventional treatments was faster and better pain relief, more efficiently better in functional disability control and very useful to improve and maintain the lumbar flexibility for the patients with SNSLBP.

Therefore, we believe that combining the ET to the conventional treatments has better improvement in treating patients with SNSLBP. All the treatments were given two weeks and there was a follow up period at the fourth week. The current study represents only immediate and short term (1 month) improvement of SNSLBP. Further study should investigate the long-term effect of combining ET to conventional treatments for the patients with SNSLBP.

Conclusion

Adding ET to the conventional treatments give the early significant pain reduction, disability decreasing and improving flexibility in lumbar spine in the sub-acute non-specific low back pain. It also supports to get the significant sustained effect of improving the symptoms for short term. The results are both clinically and statistically significant change in the intervention group. Therefore, we suggest that combining the ET to the conventional treatments has better improvement in treating patients with SNSLBP. But we investigated only immediate and short-term effects, so further study should be investigated the long-term effect of applying ET in low back pain.

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