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Comparative Impact of Kinesio Taping and Post-Isometric Muscle Relaxation on Pain and Myofascial Mechanics in Chronic Low Back Pain: A Randomized Clinical Trial

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Data Collection B
Statistical Analysis C
Data Interpretation D
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Background: This study aimed to evaluate and compare the effects of Kinesio taping (KT), with or without tension (Placebo), and post-isometric muscle relaxation (PIR) on pain intensity and the mechanical properties of myofascial tissues in chronic low back pain (LBP) patients.

Material/Methods: Study participants (n=64; females, n=34; males, n=30; mean age 41.9 years), were randomly assigned to 1 of the 3 intervention groups. The numerical rating scale (NRS) was used to assess pain intensity at rest, the Oswestry Disability Index was used to estimate the level of disability, and the MyotonPRO© device was used to measure tension, stiffness, and relaxation in the erector spinae on both sides of the lumbar spine. The examinations were performed before the intervention, after interventions, and at 7-day follow-up (RCT Id: ACTRN12624000121561).

Results: Pain and level of disability were reduced for all groups ($P<0.01$). In addition, post hoc analysis of the KT group showed significant increases in tension and stiffness of the erector spinae and significantly decreased relaxation between the pre-intervention and follow-up measurements, but only on the contralateral side ($P<0.01$).

Conclusions: KT with or without tape tension and PIR had similar effects in decreasing the level of resting pain and disability. Pain reduction was not related to changes in the mechanical properties of the soft tissue. It can be concluded that the KT with or without tape tension or PIR were mainly analgesic effects, and should be used as a combined therapy in LBP patients.

Keywords: **Athletic Tape • Biomechanical Phenomena • Complementary Therapies • Low Back Pain**

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Introduction

Nonspecific low back pain (LBP) is the most common musculoskeletal problem and affects approximately 80% of the adult population at least once during their lifetime [1]. Chronic LBP is defined as persisting for at least 3 months and resulting in pain on at least half the days in the past 6 months. The low back is the space between the lower posterior margin of the rib cage and the horizontal gluteal fold [2]. Such pain leads, in most cases, to limited mobility, increased lumbar spine stiffness, and functional disability [3,4]. LBP tends to be multifactorial; therefore, treatment can be insufficient or inefficient, so specific interventions should be investigated.

Biomechanical properties of muscle, such as tension and stiffness, are objective parameters that describe the state of tissues [5]. However, higher stiffness, known as hypertonicity, can also lead to high intramuscular pressure, negatively affecting muscle function and recovery [6]. Myofascial tone and stiffness can be positively correlated with pain and negatively correlated with elasticity in elderly LBP patients [7]. Pain intensity in adults with LBP might not be associated with stiffness of the lumbar erector spinae muscle [8]. The cause of this condition may be reduced passive spinae stiffness resulting from damage to the intervertebral disc or ligaments. These back pain patients may need additional spinae muscular stabilization [9].

It has been reported that lumbar multifidus muscle stiffness is significantly worse in LBP patients than in a pain-free control group [10], and individuals with sub-acute LBP have greater trunk stiffness than those without LBP [11]. Such differences justify further investigations into the mechanical properties of muscle to build an objective evidence base. As such, Kinesio taping (KT) could be combined with core stability exercises to improve pain and balance in LBP patients [12,13].

Kinesio tape can be stretched up to 140% of its original length, similar to the stretch capability of normal skin, and is used for treating musculature-related conditions [14]. Indeed, patients with chronic nonspecific LBP achieved better pain relief and higher activities of daily living (ADL) scores than controls when using KT [15]. Furthermore, a meta-analysis found that KT was superior to other conventional therapies, such as physical therapy, combined massage, strength training, endurance training, acupuncture, and high- or medium-frequency electric therapy, in relieving pain and improving ADL in nonspecific LBP patients [15]. Nonetheless, it is suggested that KT is a complementary therapy that helps to reduce pain and disability while also enhancing the lumbar flexion range of motion when used in conjunction with conventional physical therapy, including transcutaneous electrical nerve stimulation and supervised exercise therapy [16].

The post-isometric relaxation (PIR) technique is based on exerting optimal resistance through the work of the patient and therapist and can induce change via reflex mechanisms. The technique reduces tension within a muscle or group of muscles and increases muscle tolerance to stretch, which may be caused by isometric contraction-induced stimulation of the Golgi tendon organs [17-19]. Unfortunately, studies on the effect of the muscle energy technique on pain in patients with nonspecific back pain provide low-quality evidence [18]. However, investigating other stretching and movement-related interventions may provide further insight into the mechanistic changes and influencing factors [20].

The literature recommends using KT with other modalities. By testing different tape tension levels (0% and 15-20%), this study attempted to identify the optimal methodology. Therefore, it was necessary to use the tape as a standalone method to exclude the influence of additional factors.

This study aimed to evaluate the effects of 3 specific physiotherapeutic interventions used singly, as not combined therapy – Kinesio taping (KT), with low tension or without tape tension (Placebo), or post-isometric muscle relaxation (PIR) – on pain intensity and disability, and the mechanical properties of myofascial tissues in chronic low back pain (LBP) patients. The effects were assessed subjectively as pain intensity and disability and measured objectively as a state of tension and tissue viscoelasticity. The study hypothesis stated that applying KT or PIR would reduce pain intensity at rest and level of disability. We sought to determine the biomechanical effects on muscle tone, stiffness, or relaxation time in the soft tissue of the lumbar spine extensor.

Material and Methods

Ethics

The Wrocław University of Health and Sport Sciences' Ethics Committee approved the study procedures (14.02.2020) and the study was carried out according to the World Medical Association Declaration of Helsinki. The approval was received based on the resolution of the Senate of the University of Physical Education in Wrocław dated December 20, 2002, regarding the establishment of the Senate Committee on Ethics in Scientific Research, and the resolution of November 4, 2003, governing the procedures, as well as in accordance with Article 27 of the Act of June 6, 1997, the Code of Ethics (Journal of Laws of 1997, No. 553, as amended), and the principles outlined in "Good Practices in Science: A Collection of Principles and Guidelines" by the Ethics Committee in Science of the Polish Academy of Sciences from 2001. Before study initiation, each subject was informed about the form of the study and their right to refuse to participate or withdraw at any time. All subjects provided written consent to participate in the study.

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Table 1. Demographics before the intervention.

	PIR (n=20) (females=10; males=10)		KT (n=21) (females=11; males=10)		KT-PEBO (n=23) (females=13; males=10)		ANOVA
	M±SD	Me	M ± SD	Me	M ± SD	Me	F/H; p-value
Age (years)	41.7±9.26	41.5	39.62±7.80	39	44.48±5.70	46	F(2, 61)=2.24; p=0.11
Body mass (kg)	77.85±18.06	78	77.71±12.02	80	82.91±13.06	82	F(2, 61)=0.92; p=0.40
Height (m)	1.75±0.11	1.74	1.70±0.091	1.68	1.73±0.084	1.71	F(2, 61)=1.02; p=0.36
BMI (kg/cm²)	25.32±5.08	24.7	26.60±3.61	26.8	27.68±4.06	27.4	F(2, 61)=1.63; p=0.20
NRS (0-10)	3.00±1.78	2	3.95±1.28	4	4.09±1.81	4	H (2, 64)=5.4; p=0.06
ODI [score]	9,30±4,82	9	15,52±7,51	13	13,83±8,15	13	F(2, 64)=2.07; p=0.13

BMI – body mass index; PIR – post-isometric muscle relaxation group; KT – kinesio taping group; KT-PEBO – placebo; M±SD – mean±standard deviation; Me – median; N – number; NRS – Numerical Rating Scale; ODI – Oswestry disability index; H – Kruskal-Wallis test.

Study Design

This study was a parallel-arm, patient-blinded, randomized controlled trial. The trial protocol was conducted from March 2020 to April 2021, retrospectively registered at the Australian, New Zealand Clinical Trials Registry (RCT Id: ACTRN12624000121561; date registered: 09/02/2024).

Participants

Study participants were recruited via word of mouth, posters, and social media, and comprised 64 patients with chronic nonspecific LBP (34 females, 30 males). The age and sex distribution were similar in each intervention group (**Table 1**).

Inclusion and Exclusion Criteria

Based on the definition of nonspecific chronic low back pain, the inclusion criteria were: localized back pain between the 12th rib and the gluteal folds lasting more than 3 months [2,21], pain intensity on the numerical rating scale between 1 and 6 on the day of examination, and participants aged 20-60 years. Exclusion criteria included neurological and rheumatoid diseases, radiating pain below the buttock fold, and recent post-traumatic orthopedic diseases.

Randomization and Blinding

The sample was randomly allocated into 3 groups (PIR, KT, KT-PEBO) by block randomization (1: 1: 1 allocation ratio) using computer-generated allocation schedule (http://www.randomization.com). The allocation of the participants was concealed by using sequentially numbered, sealed, opaque envelopes. Each participant was assigned to 1 of the research groups undergoing a selected therapeutic intervention: PIR, KT, or placebo (KT-PEBO). The KT-PEBO group received a blinded placebo kinesio taping with no tension (**Figure 1** Consort flow diagram).

Outcome Measures

All participants had to be tested 3 times for the study to be fully conducted: before intervention (PRE), after completion of treatment (POST), and after a further 7 therapy-free days (FOL) to evaluate the effect of the interventions.

Primary Outcome Measure

Pain intensity was assessed using the Numeric Rating Scale (NRS). The intraclass correlation coefficient (ICC) for the test-retest reliability of the triple NRS was 0.61 to 0.77, and the minimal clinically important difference (MCID) was reported to be 2 points [21]. The Oswestry Disability Index (ODI) assessed level of disability. The ODI consists of 10 patient-completed questions in which the response options are presented as 6-point Likert scales. It is scored from 0 to 5, with 0 representing no difficulty in the activity and 5 representing maximal difficulty. The scores from each section are totaled and divided by the total possible score to obtain a final percentage of disability, with a higher percentage indicating greater disability [22]. The Polish version of the Oswestry Disability Index was used, which is a reliable and valid instrument for

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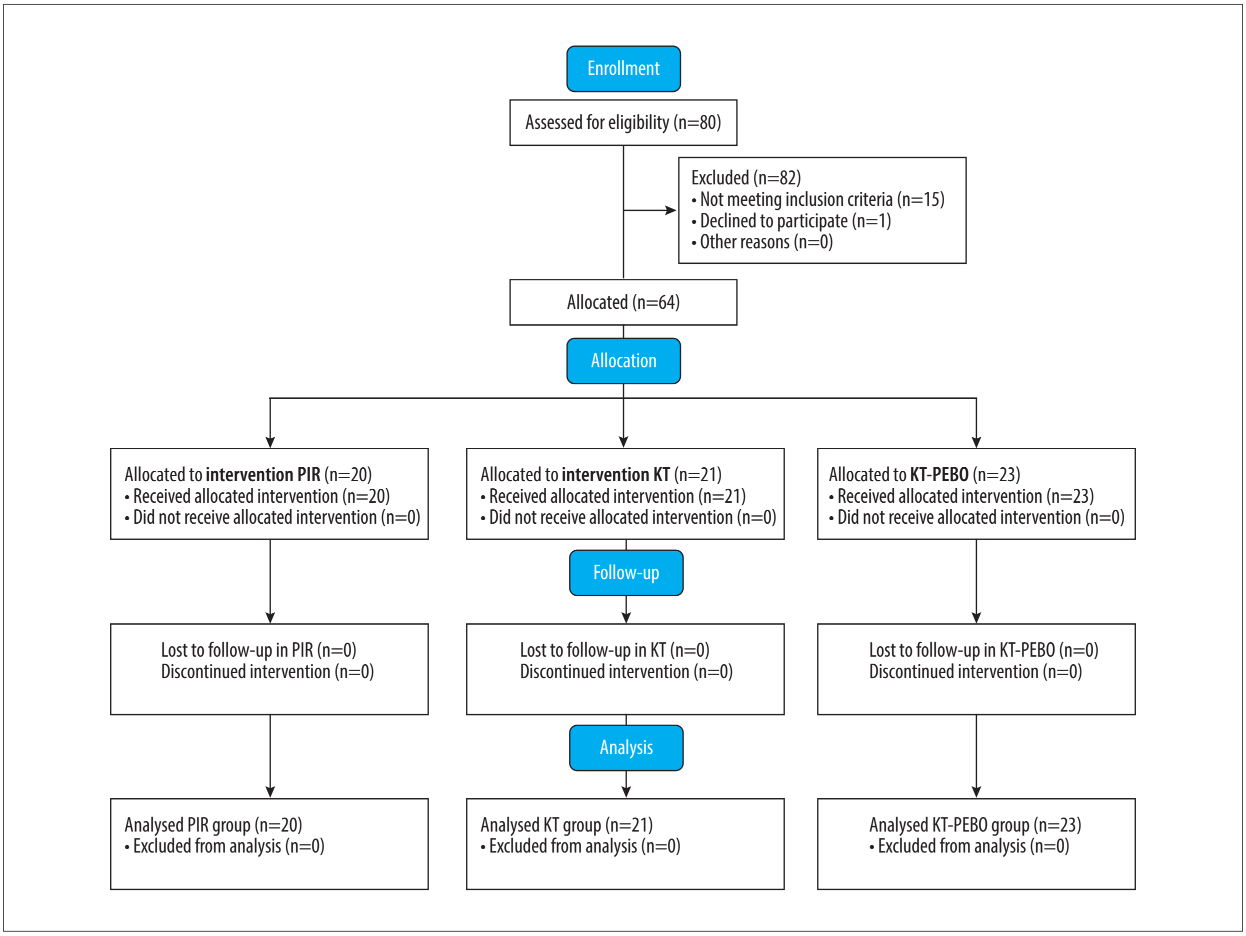

Figure 1. Consort flow diagram.

measurement of disability in Polish-speaking patients with lower back pain [23].

Secondary Outcome Measures

The non-invasive MyotonPRO© diagnostic tool (Myoton AS, Tallinn, Estonia) was used to measure biomechanical properties in the lumbar region after causing mechanical deformation of the soft tissue by applying 15-ms mechanical pulses and a mechanical force of 0.40 N. All measurements were taken in the supine position with hands positioned to the side of the body. The assessors were blinded to participant group assignments. The erector muscles of the spine were examined at the L2 spinous process level at the same points on both sides. Myotonometry was performed using a device that applies small compressive forces to the skin and measures deformation of superficial tissues. The probe of the device (3-mm diameter) was placed perpendicular to the surface of the skin, and the device program distributed 5 mechanical impulses to the muscles and recorded frequency (Hz), dynamic stiffness (N/m), relaxation time (ms), state of tension, and tissue viscoelasticity [24]. According to the MyotonPRO© website, muscle stiffness refers to the ability to resist changes in muscle shape caused by an external force. The mechanical stress relaxation time characterizes the tissue's recovery time from such displacement. Maintaining structural stability depends on resting muscle tension. Higher muscle tension or stiffness results in faster shape recovery and a lower value obtained (https://www.myoton.com/ accessed: 2024-08-28).

The analysis was based on the mean value of 3 consecutive measurements on the dominant (D) and contralateral sides (CS). The myotonometer between-day and intra-rater reliability was reported to be acceptable when used to measure muscle tone and stiffness in young adults with chronic LBP in an outpatient setting [25].

Interventions

The study was realized in a private clinic by a physiotherapist experienced in manual therapy. Muscle shortness and tightness were treated by manual self-stretching. The participants underwent post-isometric muscle relaxation for their erector spinal muscle (PIR). They did 3 sets of PIR exercises for 7 days.

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Figure 2A. Post-isometric muscle relaxation exercise.

In each treatment series, the participants did 5 repetitions of muscle tension and relaxation. Each tension phase lasted 5-7 seconds, followed by a 3-4-second relaxation phase where they stretched the erector spinal muscle [17-19]. The patients performed the exercise lying on their sides, assuming a flexion position with head bent and holding the knees with the hands. The tension phase of the erector spinal muscle was an attempt to straighten the whole body, with the hands holding the knees during the exercise. The relaxation-phase stretching was an attempt to bend the entire body to the maximum, including the head (**Figure 2A**).

Participants in the KT group were taped by plaster (3NS-TEX) according to the Kenzo Kase's Kinesio Taping Method Manual [26]. The KT group underwent a 7-day intervention that included an H-shaped KT of the lumbar spine. The tape was positioned bilaterally on the erector spinal muscles parallel to the spinous processes of the lumbar vertebrae (**Figure 2B**). The first base was applied at the level of the twelfth rib, and the patch was applied with the participants in a bent forward position with a tension of 15-20%. After participants returned to the starting position, the final base was glued at the level of the sacroiliac joints (about 2-3 cm) without tension. The same application was made on the other side of the spine. Finally, the third patch was applied transversely to the first 2 with a tension correction of 70-80% using the musculoskeletal method, then the bases of the patch were glued on both sides without generating tension [27].

Figure 2B. Kinesio taping application.

The KT-PEBO group received a placebo KT (blinded), with the patches applied in an H-shape, similar to the KT group (3NS-TEX). The same type of plaster was applied from the level of the

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Table 2. ANOVA results on main effects and interactions for pain intensity (NRS), Oswestry Disability Index (ODI) and muscle tone, stiffness, and relaxation parameter. Significant results are in bold.

Factor	*F* value	*P* value	η_p^2
NRS			
Time	39.20	**0.043**	0.40
Group	0.58	0.56	0.02
Time × group	1.9	0.11	0.06
ODI			
Time	29.65	**<0.001**	0.33
Group	2.89	0.06	0.09
Time × group	0.75	0.46	0.03
Tone			
Time	6.563	**0.002**	0.10
Group	0.626	0.538	0.02
Time × group	0.69	0.60	0.02
Side	0.805	0.37	0.01
Time × group × side	1.04	0.39	0.034
Dynamic stiffness			
Time	6.87	**0.001**	0.10
Group	0.07	0.93	0.002
Time × group	1.136	0.34	0.037
Side	2.75	0.10	0.045
Time × group × side	2.6	0.039	0.08
Relaxation time			
Time	5.69	**0.004**	0.089
Group	0.46	0.633	0.015
Time × group	1.18	0.323	0.039
Side	0.018	0.893	0.0003
time × group × side	1.389	0.241	0.046

twelfth rib to the sacroiliac joints on both sides of the spine and laterally without tension or movement of the participant [27]. Applications had to be maintained for 7 days, if possible. In addition, subjects from all groups received instructions on how to perform everyday activities according to the principles of alignment of the spine. Ergonomic adjustments can prevent sick leave due to LBP, but the quality of evidence is very low [1].

Statistics

The STATISTICA software package (StatSoft Poland, Cracow, Poland) was used for analysis. Power analysis and sample size selection assumed a clinically significant effect size of 20% change in pain intensity [21,28], and a sample size of 60 participants was sufficient to provide a study design with acceptable power (0.8) at $P<0.05$.

The Shapiro-Wilk test determined the normality of the data distribution. Pearson's correlation coefficient was used to indicate the reliability between 2 measurements on both sides of the spine in extensor muscle tone (r=0.89), stiffness (r=0.90), and relaxation (r=0.88) in the whole group (n=64).

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Table 3. Mean, median, standard deviation, and 95% confidence intervals of frequency in the study before (PRE), after (POST), and 1 week after treatment (FOL), on the dominant side (DS) and contralateral side (CS) for the 3 study groups: post-isometric muscle relaxation (PIR), Kinesio taping (KT), and KT placebo (KT-PEBO).

Tone – frequency [Hz]						
Time/side	**Group**	**Mean**	**Median**	**SD**	**CI -95.0%**	**CI +95.0%**
I_DS	PIR	14.15	14.55	1.55	1.18	2.26
I_CS	PIR	14.01	14.45	1.62	1.23	2.37
II_DS	PIR	14.09	14.25	1.44	1.10	2.11
II_CS	PIR	14.22	14.10	2.27	1.73	3.31
III_DS	PIR	14.28	14.50	1.34	1.02	1.95
III_CS	PIR	14.50	14.60	1.75	1.33	2.56
I_DS	KT-PEBO	14.39	14.43	1.16	0.90	1.65
I_CS	KT-PEBO	14.50	14.47	1.42	1.10	2.01
II_DS	KT-PEBO	14.70	14.62	1.19	0.91	1.70
II_CS	KT-PEBO	14.54	14.45	1.00	0.77	1.42
III_DS	KT-PEBO	14.91	14.70	1.63	1.25	2.35
III_CS	KT-PEBO	14.95	14.83	1.37	1.05	1.97
I_DS	KT	14.06	13.90	1.15	0.88	1.66
I_CS	KT	14.04	13.97	1.23	0.94	1.77
II_DS	KT	14.59	14.58	1.33	1.01	1.94
II_CS	KT	14.63	14.85	1.36	1.03	1.98
III_DS	KT	14.45	14.48	1.33	1.01	1.94
III_CS	KT	15.01	14.95	1.99	1.52	2.91

DS – dominant side; CS – contralateral side; PIR – post-isometric relaxation; KT-PEBO – placebo; KT – kinesio taping; SD – standard deviation; CI – confidence interval for SD.

The one-factor (intervention group) parametric or nonparametric (Kruskal-Wallis test) ANOVA analyzed the differences between demographics (**Table 1**). Two-factor ANOVA was used to compare means between groups using the main effects of the intervention group (PIR, KT, and KT-PEBO), and treatment time (PRE, POST, and FOL) for the NRS and ODI. Three-factor ANOVA was compared between group means using the main effects of the intervention group (PIR, KT, and KT-PEBO), treatment time (PRE, POST, and FOL), dominant side (DS), and contralateral side (CS) for muscle tone, stiffness, and relaxation. The partial eta-squared (ηηP2) test was used as a measure of effect size for a repeated measures ANOVA, with an eta-square of 0.01 representing a small effect, 0.06 an average effect, and 0.14 indicating a large effect [29]. The ANOVA results are presented in **Table 2**.

The Bonferroni correction method was used for post hoc analysis. The results are presented in **Tables 3-5** as means, medians, and SD, and graphed as means and 95% confidence intervals (CI) (**Figures 3, 4**). $P<0.05$ was assumed to be significant.

Results

Demographics

There were no statistically significant differences between the 3 study groups ($P>0.05$). There were no differences in age, body mass, height, BMI index, pain intensity, or disability index between the groups ($P>0.05$). The participants' demographic data are summarized in **Table 1**.

Intensity of Resting Pain

There was a significant effect of treatment time (PRE, POST, and FOL) on pain intensity, but there was no main effect of intervention group (PIR, KT, and KT-PEBO) and no interaction between intervention group and treatment time (**Table 2**). Post hoc analysis showed a significant decrease in the NRS between PRE and FOL in the PIR group ($P=0.0047$), and between PRE and POST and PRE and FOL in the KT and KT-PEBO groups ($P<0.001$) (**Figure 3**).

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Table 4. Mean, median, standard deviation, and 95% confidence intervals of dynamic stiffness in the study before (PRE), after (POST), and 1 week after treatment (FOL), on the dominant side (DS) and contralateral side (CS) for the 3 study groups: post-isometric muscle relaxation (PIR), Kinesio taping (KT), and KT placebo (KT-PEBO).

Dynamic stiffness [N/m]						
Time/side	**Group**	**Mean**	**Median**	**SD**	**CI -95.0%**	**CI +95.0%**
I_DS	PIR	260.59	275.33	59.50	45.25	86.90
I_CS	PIR	257.21	264.50	60.20	45.78	87.92
II_DS	PIR	254.35	256.67	56.24	42.77	82.14
II_CS	PIR	262.45	257.67	67.58	51.40	98.71
III_DS	PIR	268.27	273.50	50.82	38.65	74.23
III_CS	PIR	275.27	285.83	59.17	45.00	86.42
I_DS	KT-PEBO	259.96	260.00	48.27	37.33	68.32
I_CS	KT-PEBO	264.35	271.33	47.71	36.90	67.52
II_DS	KT-PEBO	272.05	271.33	48.19	37.08	68.87
II_CS	KT-PEBO	271.47	265.83	48.08	36.99	68.71
III_DS	KT-PEBO	276.13	278.67	49.26	37.68	71.13
III_CS	KT-PEBO	279.24	277.33	50.06	38.30	72.30
I_DS	KT	248.60	246.67	51.73	39.58	74.70
I_CS	KT	248.38	249.67	47.63	36.44	68.78
II_DS	KT	272.83	257.33	58.11	44.19	84.87
II_CS	KT	271.28	265.17	51.13	38.89	74.68
III_DS	KT	258.23	269.50	53.06	40.35	77.50
III_CS	KT	283.07	287.33	58.94	44.82	86.08

DS – dominant side; CS – contralateral side; PIR – post-isometric relaxation; KT-PEBO – placebo; KT – kinesio taping; SD – standard deviation; CI – confidence interval for SD.

Oswestry Disability Index

There was significant effect of treatment time (PRE, POST, and FOL). However, there was no effect of intervention group (PIR, KT, and KT-PEBO) and no interaction between intervention group and treatment time on ODI variable (**Table 2**). The post hoc analysis showed a significant decrease in ODI between PRE and FOL measures in PIR and KT-PEBO groups ($P<0.01$), and between PRE and POST, and PRE and FOL in KT group ($P<0.01$) (**Figure 4**).

Lumbar Spine Extensor Muscle Tone, Stiffness, and Relaxation

There was a significant effect of treatment time (PRE, POST, and FOL) on muscle tone, but there was no main effect of intervention, time, or site across all intervention groups (**Table 2**). In the post hoc tests, muscle tone increased significantly between PRE and FOL examination, on the CS site, in the KT group only ($P<0.01$) (**Table 3**).

There was a significant effect of treatment time (PRE, POST, and FOL) on muscle stiffness. There was significant interaction between time, site, and group, with average effect. However, there was no main effect of intervention groups. Also, there was no interaction between time and group (**Table 2**). In addition, post hoc tests showed a difference between PRE and FOL, on the CS site, in the KT group only ($P<0.001$) (**Table 4**).

There was a significant effect of treatment time (PRE, POST, and FOL) on muscle relaxation (**Table 2**). However, there was no main effect of the intervention groups on the relaxation variable. Also, there was no significant interaction between time, group, and site. In post hoc tests, there was a difference between PRE and FOL, on the CS site, in the KT group only ($P<0.05$) (**Table 5**).

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Table 5. Mean, median, standard deviation, and 95% confidence intervals of relaxation time in the study before (PRE), after (POST), and 1 week after treatment (FOL), on the dominant side (DS) and contralateral side (CS) for the 3 study groups: post-isometric muscle relaxation (PIR), Kinesio taping (KT), and KT placebo (KT-PEBO).

Dynamic stiffness [N/m]						
Time/side	Group	Mean	Median	SD	CI -95.0%	CI +95.0%
I_DS	PIR	20.92	19.63	3.91	2.97	5.71
I_CS	PIR	21.65	20.48	4.13	3.14	6.03
II_DS	PIR	21.30	20.07	3.45	2.63	5.04
II_CS	PIR	21.48	20.87	4.46	3.39	6.52
III_DS	PIR	20.46	19.02	3.46	2.63	5.05
III_CS	PIR	20.26	19.22	3.79	2.88	5.53
I_DS	KT-PEBO	20.63	20.03	3.17	2.46	4.49
I_CS	KT-PEBO	20.33	19.77	3.21	2.48	4.54
II_DS	KT-PEBO	19.76	19.57	2.95	2.27	4.22
II_CS	KT-PEBO	20.02	19.78	3.02	2.32	4.31
III_DS	KT-PEBO	19.84	19.67	3.12	2.39	4.50
III_CS	KT-PEBO	19.70	19.60	3.06	2.34	4.41
I_DS	KT	21.22	21.83	3.22	2.46	4.64
I_CS	KT	21.40	21.23	3.54	2.71	5.11
II_DS	KT	19.86	20.25	3.26	2.48	4.75
II_CS	KT	19.80	19.52	3.30	2.51	4.82
III_DS	KT	20.47	20.13	2.73	2.08	3.99
III_CS	KT	19.47	18.88	3.67	2.79	5.36

DS – dominant side; CS – contralateral side; PIR – post-isometric relaxation; KT-PEBO – placebo; KT – kinesio taping; SD – standard deviation; CI – confidence interval for SD.

Discussion

The most important finding in our study was that over treatment time (PRE, POST, and FOL) all 3 intervention groups (PIR, KT, and KT-PEBO) had reduction of pain and level of disability. However, changes in stiffness, frequency, and relaxation times were observed only in the KT group between PRE and FOL measurements.

The observed analgesic effect of post-isometric relaxation has been confirmed [18,20]. It is similar with the specifically used taping when the elastic tape is applied to the painful area with tension [15]. The only surprising finding was that analgesic effect was also obtained in the placebo group (KT-PEBO) and was similar to those measured in KT and PIR groups. Placebo taping or sham taping most often does not reduce pain sensations to the same extent as the 2 therapeutic methods mentioned above; it is applied without tension and its mechanical impact force to the musculoskeletal system is small [30]. Reports on the effect of tape tension on pain symptoms are contradictory. In the study of Abbasi et al, substantial pain reduction was observed using KT compared to placebo taping after 3 days of therapy [31]. However, in the kinesiotaping application methodology, it is recommended to perform the application without tension [26]. Macedo et al confirmed the effectiveness of such use of taping, showing that regardless of whether the tape was applied with or without tension, an analgesic effect was observed after a 3-day treatment with KT application. However, they noticed that if the intervention was extended to 10 days, the improvement of the disability index in patients with LBP was obtained only after the use of a tape with tension compared to a tape without tension [27]. Parreira et al also indicated that the tension of the tape does not matter. They conducted a large randomized control trial designed to test whether KT applied with 10-15% tension was more effective in reducing pain than a placebo (no tension) KT application in individuals with chronic low back pain. The conclusion was that regardless of the tension, the tape does

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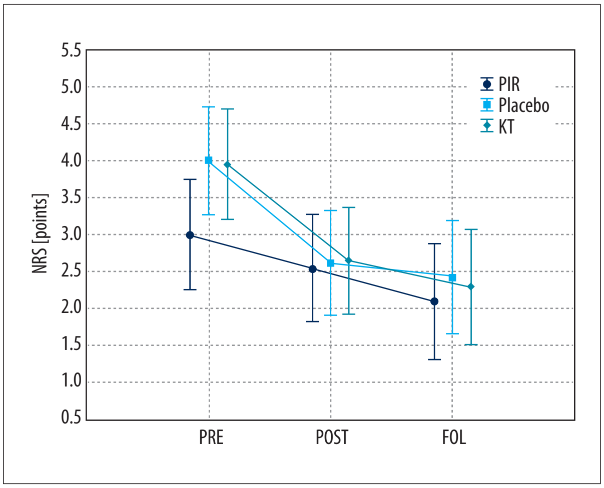

Figure 3. Means and 95% confidence intervals of the numerical rating scale (NRS) values before (PRE), after (POST), and 1 week after treatment (FOL), for the 3 study groups: post-isometric muscle relaxation (PIR), Kinesio taping (KT), and KT placebo (STATISTICA software).

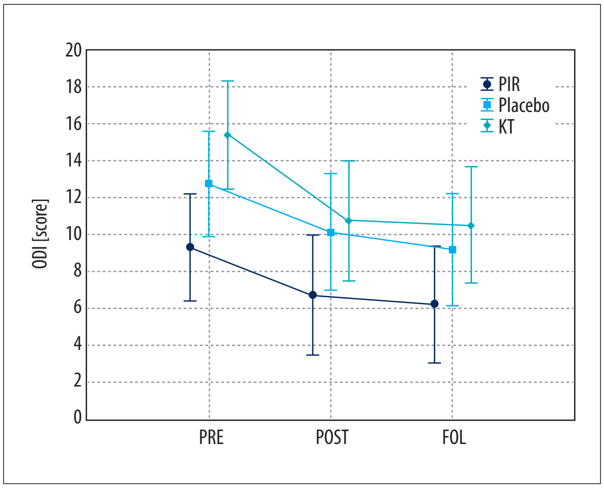

Figure 4. Means and 95% confidence intervals of Oswestry Disability Index (ODI) before (PRE), after (POST), and 1 week after treatment (FOL) for the 3 study groups: post-isometric muscle relaxation (PIR), Kinesio taping (KT), and KT placebo (STATISTICA software).

not reduce pain in patients with LBP. They added, however, that there was a small improvement in global perceived effect observed only after 4 weeks, but this was not sustained to 12 weeks [32]. Discrepancies in the results of studies on tape tension may result from the physical activity of patients with KT application during a time beyond the researcher's control. Because the stimulus provided by the tape may depend to a greater extent on the range of movements performed by the subject in the taped area. However, this is only a speculation that requires verification in studies in which this aspect would be controlled by the researchers.

In the present study, an analgesic effect was observed regardless of the tension. Two recently published reviews confirm these observations. In the first systematic review and meta-analysis, Ramirez-Velez et al (2019) compared KT with sham taping. They found no strong evidence of a beneficial effect of KT over sham taping, but when both groups ware analyzed independently, KT and sham taping groups showed significant improvement in several parameters in patients with LBP [33]. The second review, published in 2020 by Coupler et al, presented an evidence map that showed that the use of taping in chronic LBP is recommended and has a strong scientific basis [34].

The mechanical properties of paraspinal tissues represented by stiffness, frequency, and relaxation time measured immediately after the intervention did not show any significant changes. In the KT group, higher stiffness and frequency values and shorter relaxation times were observed between PRE and FOL, on the CS side. However, there were no intergroup differences in discussed mechanical properties of the paravertebral tissues. The lack of changes in the values of these parameters with a simultaneous reduction in pain immediately after the intervention may indicate that the analgesic effect of the treatment was not related to an actual change in the functional condition of the muscles. Therefore, the immediate effect of taping (KT or KT-PEBO) is not based on the treatment of the tissue itself, but it can be speculated that the sensory information provided from the taped skin disrupted the processing of pain originating from the lower back area. The idea that sensory mechanism is responsible for the effect of tape application is consistent with the conclusions from a study on healthy adults where KT was applied with low tension (25%). The conclusion was that the sensory input from tape may provide a sufficient non-nociceptive mechanical stimulation to reduce ongoing nociceptive transmission to the spinal cord, but these hypotheses regarding the mechanisms are purely speculative and should be followed up with future research [30]. Similarly, in the study on a young, healthy population provided insight into the mechanisms underlying KT therapy, demonstrating an impact on skin thickness and surface stretching. Such effects could increase proprioception and allow subjects undergoing KT to avoid postures and movements associated with injury or pain. Moreover, the changes in skin thickness could alleviate swelling associated with many lumbar pain pathologies [14,35]. This effect can be used for physical activity supporting the treatment or the use of other treatment techniques. Therefore, to achieve the best therapeutic effect, taping and post-isometric muscle relaxation should be used in combination with proven treatment techniques. There were no effects of the intervention on muscle tension, stiffness, or relaxation time in the soft tissue of the lumbar spine extensor, probably due to the use of KT as a non-combined therapy, which is recommended [12,13].

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The alteration in the mechanical properties of muscles following the application of Kinesio taping (KT) became evident only after a period of 4 weeks. However, the analgesic effect was still present. This implies that the mechanism of action of the physiotherapeutic techniques employed herein was different immediately after application compared to a prolonged period thereafter. The increases in frequency and stiffness found between the PRE and FOL tests in the KT group were present only in the CS. Such asymmetry of the spine could result from the pathologic condition in LBP patients, as cellular, morphological, and functional muscle characteristics are associated with LBP and degenerative spine disorders. Thus, they may affect mechanical properties of contractile elements and elastic connective tissues that determine flexibility and muscle tension [36]. Therefore, the multifactorial nature of LBP demands a spectrum of interventions for restoring function to the paraspinal muscles [37,38].

In a study on healthy individuals, stiffness decreased as a result of myofascial interventions [39]. Our findings suggest that KT therapy may increase stiffness in LBP patients, which is a novel observation. The increase in stiffness mentioned above can be interpreted as positive because these parameters approach the normative values. Indeed, the tension, stiffness, and relaxation values in the KT group approached the average normative values for a given age [8], but only on the CS side. The stiffness of the erector spinae muscle at the L3-L4 level in healthy people aged 38.0±12.0 was shown to be 290.12±72.15 on the left side and 301.89±85.04 N/m on the right side [40], with no side-to-side differences identified when applying *t* tests to measurements in LBP and Control groups [41], indicating the symmetry of stiffness as the normative value.

A systematic review with meta-analysis revealed low-to-moderate certainty of evidence of higher resting multifidus and erector spinae muscles stiffness; it measured ultrasound-based measurements or myotonometry in individuals with LBP compared with asymptomatic controls [42]. Another study found no significant association between pain intensity and muscle stiffness and tone in chronic LBP. However, an association was observed between the mechanical properties of muscle and disability level. Therefore, muscle tone and stiffness measured by a myotonometer may be reliable outcome measures for assessing intervention-induced changes [40]. Increased back muscle stiffness could play a role in the persistence of symptoms and could represent a potential treatment goal in LBP management. Additionally, muscle stiffness may be used as an outcome measure for the evaluation of progress in patients with LBP [42].

The present study is limited to the application of Kinesio taping or post-isometric muscle relaxation alone, which may not reflect the current clinical practice of many therapists. An important limitation of this study was the fairly large age range of the participants, as other studies reported changes in the mechanical properties of soft tissues in young adults and older adults [41], and males and females [43]. The Research Task Force on Research Standards for chronic LBP chose not to make specific recommendations for the timing of outcome assessments because appropriate timing would vary depending on an intervention. For some treatments (eg, analgesics or spinal manipulation), the goal may be short-term relief [2]. A standard minimum pain assessment for back pain patients should integrate pain intensity (VAS or NRS) and pain-related disability. As in VAS, a change on the NRS of 20% between 2 time-points of an assessment is regarded as being clinically significant [28]. The creators of the ODI suggested that a final ODI score of 20% or less represented no disability [22], but the minimally clinical important change ODI score is a unique concept that is likely different for each patient and that a single value does not appropriately capture change for everyone [44]. There were no data for muscle activity interpretation [45]. Nonetheless, the limitations of the technology should not impact the reliability of the analysis since all measurements were consistent across groups. Future research should focus on the effects of manual interventions with different clinical significance thresholds, depending on acute or chronic settings, and other intensity of LBP.

Conclusions

KT with or without tape tension or PIR had similar effects in decreasing the level of resting pain and disability, although there were no intergroup differences in the numerical pain scale, the ODI, or selected mechanical properties of the paravertebral tissues. Pain reduction was not related to changes in the mechanical properties of the soft tissue. The pain reduction occurred immediately after the intervention, indicating that the applied stimulus reflexively inhibited the pain information traveling to the central nervous system. It can be concluded that the KT with or without tape tension or PIR were mainly analgesic effects, and should be used as a combined therapy in LBP patients. The methods of KT application (tension, time, movement, region) may need to be modified to achieve results that warrant their use.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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References:

1. Steffens D, Maher CG, Pereira LS, et al. Prevention of low back pain: A systematic review and meta-analysis. JAMA Intern Med. 2016;176(2):199-208
2. Deyo RA, Dworkin SF, Amtmann D, et al. Report of the NIH Task Force on research standards for chronic low back pain. Int J Ther Massage Bodywork. 2015;8(3):16-33
3. Jonsson E, Nachemson A. Neck and back pain, the scientific evidence of causes, diagnosis, and treatment. Philadelphia: Lippincott Williams & Wilkins. 2000;165-87
4. Shum GL, Crosbie J, Lee RY. Energy transfer across the lumbosacral and lower-extremity joints in patients with low back pain during sit-to-stand. Arch Phys Med Rehabil. 2009;90(1):127-35
5. Lohr C, Braumann KM, Reer R, et al. Reliability of tensiomyography and myotonometry in detecting mechanical and contractile characteristics of the lumbar erector spinae in healthy volunteers. Eur J Appl Physiol. 2018;118(7):1349-59
6. Kelly JP, Koppenhaver SL, Michener LA, et al. Characterization of tissue stiffness of the infraspinatus, erector spinae, and gastrocnemius muscle using ultrasound shear wave elastography and superficial mechanical deformation. J Electromyogr Kinesiol. 2018;38:73-80
7. Wu Z, Wang Y, Ye Z, et al. Effects of age and sex on properties of lumbar erector spinae in healthy people: Preliminary results from a pilot study. Front Physiol. 2021;12:718068
8. Li Y, Yu J, Zhang J, et al. Quantifying the stiffness of lumbar erector spinae during different positions among participants with chronic low back pain. PLoS One. 2022;17(6):e0270286
9. van Dieën JH, Selen LP, Cholewicki J. Trunk muscle activation in low-back pain patients, an analysis of the literature. J Electromyogr Kinesiol. 2003;13(4):333-51
10. Masaki M, Aoyama T, Murakami T, et al. Association of low back pain with muscle stiffness and muscle mass of the lumbar back muscles, and sagittal spinal alignment in young and middle-aged medical workers. Clin Biomech. 2017;49:128-33
11. Freddolini M, Strike S, Lee RY. Stiffness properties of the trunk in people with low back pain. Hum Mov Sci. 2014;36:70-79
12. Jung KS, Jung JH, In TS, Cho HY. Influences of kinesio taping with therapeutic exercise in patients with low back pain. Healthcare (Basel). 2021;9(8):927
13. Senbursa G, Pekyavas NO, Baltaci G. Comparison of physiotherapy approaches in low back pain: a randomized controlled trial. Korean J Fam Med. 2021;42(2):96-106
14. Paoloni M, Bernetti A, Fratocchi G, et al. Kinesio taping applied to lumbar muscles influences clinical electromyographic characteristics in low back pain patients. Eur J Phys Rehabil Med. 2011;47(2):237-44
15. Sheng Y, Duan Z, Qu Q, et al. Kinesio taping in treatment of chronic non-specific low back pain: A systematic review and meta-analysis. J Rehabil Med. 2019;29:734-40
16. Mohamed SHP, Hamad S, Amer A, Gopal N. The effectiveness of kinesio taping and conventional physical therapy in the management of chronic low back pain: A randomized clinical trial. Clinical Rheumatology. 2023;42:233-44
17. Greenman PE. Principles of manual medicine. Williams & Wilkins, 1996, 462; 514
18. Franke H, Fryer G, Ostelo RW, Kamper SJ. Muscle energy technique for non-specific low-back pain. Cochrane Database Syst Rev. 2015;2015(2):CD009852
19. Day JM, Nitz AJ. The effect of muscle energy techniques on disability and pain scores in individuals with low back pain. J Sport Rehabil. 2012;21(2):194-98
20. Hamilton RI, Garden CLP, Brown SJ. Immediate effect of a spinal mobilisation intervention on muscle stiffness, tone and elasticity in subjects with lower back pain – a randomized cross-over trial. J Bodyw Mov Ther. 2022;29:60-67
21. Childs JD, Piva SR, Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. Spine. 2005;11:1331-34
22. Fairbank J, Couper J, Davies J, O'Brien JP. The Oswestry low back pain questionnaire. Physiotherapy. 1980;66:271-73
23. Miekisiak G, Kollataj M, Dobrogowski J, et al. Validation and cross-cultural adaptation of the Polish version of the Oswestry Disability Index. Spine (Phila Pa 1976). 2013;38(4):E237-43
24. Bravo-Sánchez A, Abián P, Sánchez-Infante J, et al. Objective assessment of regional stiffness in vastus lateralis with different measurement methods: A reliability study. Sensors. 2021;21:3213
25. Hu X, Lei D, Li L, et al. Quantifying paraspinal muscle tone and stiffness in young adults with chronic low back pain: A reliability study. Sci Rep. 2018;8(1):14343
26. Kase K, William J, Tsuyoshi K. Clinical therapeutic applications of the kinesio taping method. 2nd ed Tokyo. 2013;19-39
27. Macedo LB, Richards J, Borges DT, et al. Kinesio taping reduces pain and improves disability in low back pain patients: A randomised controlled trial. Physiotherapy. 2019;105(1):65-75
28. Haefeli M, Elfering A. Pain Assessment. Eur Spine J. 2006;15:S17-S24
29. Alzughbi T, Badedi M, Darraj H, et al. Diabetes-related distress and depression in Saudis with type 2 diabetes. Psychol Res Behav Manag. 2020;15:453-58
30. Naugle KE, Hackett J, Aqeel D, Naugle KM. Effect of different kinesio tape tensions on experimentally-induced thermal and muscle pain in healthy adults. PLoS One. 2021;16(11):e0259433
31. Abbasi S, Rasanani MR, Ghotbi N, et al. Short-term effect of kinesiology taping on pain, functional disability and lumbar proprioception in individuals with non-specific chronic low back pain: a double-blinded, randomized trial. Chiropr Man Therap. 2020;28:63
32. Parreira PDS, Costa LDM, Takahashi R, et al. Kinesio taping to generate skin convolutions is not better than sham taping for people with chronic non-specific low back pain: A randomized trial. J Physiother. 2014;60(2):90-96
33. Ramirez-Velez R, Hormazabal-Aguayo I, Izquierdo M, et al. Effects of kinesio taping alone versus sham taping in individuals with musculoskeletal conditions after intervention for at least one week: a systematic review and meta-analysis. Physiotherapy. 2019;105(4):412-20
34. Cupler ZA, Alrwaily M, Polakowski E, et al. Taping for conditions of the musculoskeletal system: An evidence map review. Chiropr Man Therap. 2020;28(1):52
35. Cimino SR, Beaudette SM, Brown SH. Kinesio taping influences the mechanical behaviour of the skin of the low back: A possible pathway for functionally relevant effects. J Biomech. 2018;67:150-56
36. Noonan AM, Brown SHM. Paraspinal muscle pathophysiology associated with low back pain and spine degenerative disorders. JOR Spine. 2021;4(3):e1171
37. Żywień U, Barczyk-Pawelec K, Sipko T. Associated risk factors with low back pain in white-collar workers: a cross-sectional study. J Clini Med, 2022;11:1275
38. Sipko T, Glibowski E, Kuczyński M. Acute effects of proprioceptive neuromuscular facilitation exercises on the postural strategy in patients with chronic low back pain. Complement Ther Clin Pract. 2021;44:101439
39. Bohlen L, Schwarze J, Richter J, et al. Effect of osteopathic techniques on human resting muscle tone in healthy subjects using myotonometry: A factorial randomized trial. Sci Rep. 2022;12:16953
40. Lo WLA, Yu Q, Mao Y, et al. Lumbar muscles biomechanical characteristics in young people with chronic spinal pain. BMC Musculoskelet Disord. 2019;20(1):559
41. Alcaraz-Clariana S, García-Luque L, Garrido-Castro JL, et al. Influence of spinal movements associated with physical evaluation on muscle mechanical properties of the lumbar paraspinal in subjects with acute low back pain. Diagnostics (Basel). 2022;12(2):302
42. Vatovec, R., Voglar, M. Changes of trunk muscle stiffness in individuals with low back pain: A systematic review with meta-analysis. BMC Musculoskelet Disord. 2024;25:155
43. Mencel J, Jaskólska A, Marusiak J, et al. Effect of gender, muscle type, and skinfold thickness on myometric parameters in young people. PeerJ. 2021;9:e12367
44. Schwind J, Learman K, O'Halloran B, et al. Different minimally important clinical difference (MCID) scores lead to different clinical prediction rules for the Oswestry disability index for the same sample of patients. J Man Manip Ther. 2013;21(2):71-78
45. Kós RS, Janssen TWJ, Cliquet Junior A. Arm function and muscle activity responses after using the Kinesio taping inhibitory technique. Hum Mov. 2022;23(3):65-71

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