Effect of kinesio taping on chronic mechanical neck pain: a randomized controlled trial

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Objective
The purpose of this study was to investigate the effect of kinesio taping (KT) combined with exercises on pain, functional disability, and cervical range of motion (CROM) for patients with chronic mechanical neck pain (MNP) after 1 and 6 weeks of intervention.
Patients and methods
A total of 60 patients with MNP participated in this randomized clinical trial; their age ranged from 30 to 40 years. They were assigned randomly into two equal groups: the control group received infrared, stretching, isometric, and strengthening exercises 3 days per week for 6 weeks, and the experimental group received KT in addition to the same program as the control group. Pain level, neck function, and CROM were measured by visual analog scale, neck disability index (NDI), and CROM, respectively. Data were collected at baseline, after 1 week, and after 6 weeks of intervention for both groups.
Results
Multivariate analysis of variance test showed a significant reduction in pain level (F=6.588, P=0.016), and NDI (F=4.961, P=0.034) after 1 week favoring the experimental group. There was a main significant effect of time ($P<$ 0.05) after 6 weeks; however, there was no significant interaction for pain, NDI, and CROM after 6 weeks ($P>$ 0.05).
Conclusion
KT combined with conventional treatment after 1 week was found to be effective in improving pain, and functional ability than conventional treatment alone in patients with MNP, while there was no difference between both groups after 6 weeks.

Keywords:
chronic mechanical neck pain, conventional treatment, exercises, kinesio taping

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Introduction

Neck pain has been a major public health burden and a common musculoskeletal disorder for many years [1,2]. Chronic mechanical neck pain (MNP) affects about 30–50% of the general population, with high prevalence in the middle-aged people. MNP produces mobility restriction, functional disability, decrease in muscle strength, and decrease in health-related quality of life; moreover, it is one of the main causes of work absenteeism [1,3].

The available literatures provide different treatment strategies for MNP; these include pharmacological therapy, manual therapy, stretching exercises, active exercises, traction, and electrotherapy [3,4]. However, the growing magnitude and socioeconomic impact of MNP demand that more researches be conducted on the efficacy of treatment intervention. As more studies are accumulating, the influence of a number of factors on the results can be explored [4].

Kinesio taping (KT) is a passive intervention method used clinically for the management of pain [5]; it was developed in Japan by KensoKase in the 1970s, but its use has become more popular in recent years [6]. It has been hypothesized that KT may produce its effects through (a) pain reduction; (b) stimulation of blood circulation; (c) diminishing of edema by improving lymph circulation; (d) induction of muscle relaxation which provide correction of joint position; and (e) providing support and stability to the muscles and joints without limiting the range of motion (ROM) [5,7,8].

Many studies have proved that KT has positive effects on reduction of shoulder pain, patellofemoral pain syndrome, pain during sports injury, low back pain, and neck pain [9]; on the other hand, some studies have

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not found significant pain relief with the use of KT [10,11].

Several authors have studied the effectiveness of KT in the management of MNP [7,11]. Variability of the site, tension, and duration of KT application among studies may affect its outcomes; in some studies KT was applied as a Y-shaped strip from the dorsal region (T1–T2) to the upper-cervical region (C1–C2) and the overlying band was a space-tape placed perpendicular to the Y strip, over the (C3–C6) region [7,12]; however, in other studies the application was different as the Y strip started from the thoracic vertebrae (T3–T5) to the occiput of the skull, and the overlying strip was placed at the middle of the neck [3,13]. The amount of tension could be another factor that affects the results; in a study performed by González *et al.* [12] the tension between 15 and 25% was more effective than the application of the tape without tension.

Most of the studies conducted on MNP investigated the immediate effect of KT; in a study performed by Saavedra-Hernández *et al.* [7], they compared between KT and cervical manipulation, and the outcomes were assessed after 1 week of treatment, the results have shown that the patients of both groups exhibited similar improvements in neck pain intensity, disability, and cervical range of motion (CROM), but the changes in neck disability index (NDI) and ROM were small and not clinically meaningful.

Similarly González *et al.* [12] studied the immediate effect of KT on acute cases of whiplash injuries and they reported a significant improvement immediately after the application of KT and after 24-h follow-up as compared with sham tape. On the other hand, Rojan *et al.* [14] failed to conclude if there was an immediate effect of KT on neck pain and they recommended further studies to illustrate this effect. Mostafavifar *et al.* [9] and Taylor *et al.* [15] in their reviews concluded that KT may provide immediate pain relief following the application, but there is insufficient evidence to support sustained relief beyond that time and they recommended future studies to examine the longer term benefits of KT as this would have a greater value in clinical practice.

It appears to be evident that more research is needed in order to investigate KT efficacy with a more detailed protocol description concerning site, tension, frequency, and different duration of application through the rehabilitation program [7]. Therefore, the purpose of this study was to clarify the efficacy of adding KT to the conventional exercises and to illustrate the effect of different durations of KT application (1 and 6 weeks) on pain, functional ability, and active ROM for patients with MNP.

Patients and methods

Study design

This study was a randomized, double-blinded controlled trial. The participants were randomized using a computer-generated random number sequence and allocated into two groups by the sealed envelope method. Each patient randomly chose an envelope and gave it to the physiotherapist. Both patients and the examining physiotherapist were blinded to the treatment allocation. Only the physiotherapist who applied the therapy was aware of the procedure.

Participants

Sixty patients with MNP were recruited from the outpatient clinic of the Faculty of Physical Therapy, Cairo University and Kasr Al-Ainy Hospital to participate in this trial. They were randomly assigned into two equal groups; the control group received infrared, stretching, isometric, and strengthening exercises 3 days per week for 6 weeks, while the experimental group received KT replaced every 4 days in addition to the same program of the control group.

The sample size was performed using G*power 3.1 software (Universities, Dusseldorf, Germany). The calculation was based on a pilot study; the primary clinical outcome of the current study was pain intensity that determined to obtain a power of 0.85 with an alpha level of 0.05 with an effect size of 0.88; the total sample-size estimation would be 25 participants per group and to account for dropout rates, the sample size was increased to 30 each group.

The study protocol was approved by the research ethics committee, Faculty of Physical Therapy, Cairo University (REC/012/001466) and the registration number was (PACTR201807172888217). All the participants who met the inclusion criteria were given an informed consent and signed it to begin the study. All the procedures were conducted in accordance with the Declaration of Helsinki.

Inclusion criteria of participants enrolled in this study were men and women aged from 30 to 40 years with a history of MNP for more than 3 months; MNP was defined as generalized neck or shoulder pain aggravated by persistent neck postures, neck movement, or palpation of the cervical musculature. The patients

were excluded from the study if they had one of the following criteria: severe disorders of the cervical spine such as disk prolapse and cervical stenosis, previous history of surgery or fracture of cervical or thoracic spine, whiplash injury, inflammatory rheumatic diseases, pregnant women, and KT allergy.

Outcome measures

The primary outcome was neck pain intensity; it was measured by using the visual analog scale (VAS); the secondary outcomes were functional disability using the Arabic version of NDI and neck flexion, extension, side bending, and rotation ROM using the CROM device. All outcomes were collected at baseline, and 1 week after starting the intervention, and again repeated after the end of the intervention.

Pain intensity: VAS is a horizontal line of 0 cm, where 0 represented 'no pain' on the left and 10 represented 'worst pain' on the right. VAS is a valid and reliable method for pain assessment and it is appropriate for use in clinical practice [16].

Functional disability

Assessed by NDI, it consists of 10 sections addressing functional activities with six possible responses for each section (from 0 to 5). The NDI is scored from 0 to 50, with higher scores indicating greater disability [17,18]. Disability percent can be obtained by doubling of the score, which is minimum (0–20%), moderate (21–40%), severe (41–60%), invalidating (61–80%), and bed bound (80–100%). Reliability and validity of the NDI have been well established [19,20].

Cervical range of motion

A CROM device was used to assess flexion, extension, right lateral flexion, left lateral flexion, rotation to right, and rotation to the left. The participant was instructed to sit comfortably on a chair, with straight back, hips, and knees at 90° of flexion, and feet flat on the floor. A CROM device was placed on the top of the head as if putting on a pair of glasses; then the patient was asked to move the head as far as he can without pain in a standard manner. Three trials were conducted for each direction of movement, and the mean values of the three trials were recorded for analysis. The CROM goniometer has been shown to be valid and reliable in all movement directions, it shows an intratester reliability of between 0.87 and 0.96 in patients with neck pain [21,22].

Intervention

Kinesio tape application: sensitivity test was carried out before applying the KT. A small piece was applied on the inner part of the arm and kept for 24 h. Next day the area was checked for any abnormal allergic reaction. The tape used in this study was waterproof, porous, and adhesive, with 5 cm width and 0.5 cm thickness (Kinesio Tex, made in Japan). The KT group received a standardized KT application in sitting position. The posterior aspect of the neck was exposed, cleaned with water, and shaved so that the tape was properly applied. The first part was a 15 cm Y-shaped strip placed over the posterior neck muscles and applied from the dorsal region (T1–T2) to the upper-cervical region (C1–C2). The tape was applied with ~15–25% stretch. Each end of the Y-shape strip was applied while the patients' neck is in a position of cervical contralateral side bending and rotation. Another overlying 10 cm strip (I shape) with moderate tension was applied perpendicular to the Y strip over at the level of C3–C6. The tape was applied and replaced every 4 days (Fig. 1) [15].

Figure 1

Application of kinesio taping.

Infrared radiation: all the patients in both groups received an infrared radiation for a 15 min/session. The patient assumed a forward lean sitting position to obtain optimal support and maximum relaxation. The lamp was positioned at a distance ranging from 50 to 75 cm, for three sessions per week for 6 weeks [23].

Exercise training in the form of stretching exercises were performed for levator scapulae, upper fibers of trapezius, sternocleidomastoid and scalene muscles; the stretching was maintained for 30 s, followed by 30 s

relaxation; three repetitions were done [24]. Isometric exercises that were conducted for extensors, side-bending muscles for both sides and rotators for both sides, for 6 s contraction followed by 6 s relaxation, repeated five times for each direction [25].

Strengthening exercises: strengthen the deep cervical flexors by assuming chin tucks in the supine position with the head in contact with the plinth. For progression of this exercise, the patient was instructed to lift the head off the floor in a tucked position and holding it for varying lengths of time (this process progressed in two-second increments starting at two seconds, i.e., 2, 4, 6, and 8 s) [26]. Strengthening exercises for shoulder retractors using a theraband by pulling the shoulder back from standing and prone lying position; the patient was asked to pinch the scapulae together, holding this position for at least 6 s and then relaxing. The progression of this exercise involved conducting the shoulder retraction from a prone position using weights [27].

Strengthening exercises for serratus anterior: the patient was instructed to stand at the wall with arms approximately shoulder width apart and was then asked to push the wall away until the elbows are fully extended and the scapulae are protracted as far as possible. This conventional treatment was to be repeated three times per week for 6 weeks for both groups [27].

Statistical analysis

Data were explored for normality by checking the distribution of data, using the Shapiro–Wilk test, drawing histogram and box blot, calculating the mean, median, and mode values. All parameters that were measured (VAS, NDI, and CROM) showed a parametric distribution. Two-way mixed model multivariate analysis of variance was used to compare between measured parameters in both groups and across different time periods. For demographic data of the participants, independent *t* test was used. Numerical data was presented as mean and SD. The significance level was set at a *P* value of less than or equal to 0.05. Statistical analysis was performed with IBM SPSS Statistics, version 20 (SPSS Inc.,Chicago, Illinois, USA).

Results

There was no significant difference between both groups concerning age, weight, height, BMI, and sex as the *P* values were ($P>$ 0.05) as shown in Table 1. The results indicated statistically significant group-by-time interaction for neck pain (F=6.588, P=0.016) after 1 week of treatment and no significant interaction after 6 weeks of treatment (F=0.099, P=0.892). The patients who received conventional treatment combined with KT experienced greater decrease in pain intensity after 1 week and there was similar improvement in both groups after 6 weeks.

Table 1 Demographic characteristics of the patients

	Experimental group (N=30) (mean±SD)	Control group (N=30) (mean±SD)	*P* value
Age (years)	35.6±2.43	37.83±3.54	0.748
Sex (male : female)	10 : 20	8 : 22	0.79
Weight (kg)	79.46±9.84	78.03±5.46	0.65
Height (cm)	167.6±4.74	168.1±5.03	0.75

P value: significance level. SD: Standard deviation, N: number.

Regarding the NDI, there was a statistically significant group-by-time interaction for NDI (F=4.961, P=0.034) after 1 week of treatment and no significant interaction after 6 weeks of treatment (F=0.336, P=0.567). The patients who received conventional treatment combined with KT experienced greater decrease in NDI after 1 week and there was similar improvement in both groups after 6 weeks.

Concerning CROM, it was statistically significant for flexion (F=5.998, P=0.021), left side bending (F=8.421, P=0.007), and right rotation (F=5.701, P=0.024) after 6 weeks of treatment. There was no significant interaction for CROM for flexion (F=0.361, P=0.553) after 1 week, extension (F=0.001, P=0.971 and F=0.066, P=0.799) after 1 and 6 weeks of treatment, respectively, right-side bending (F=0.059, P=0.809 and F=2.113, P=157) after 1 and 6 weeks of treatment, respectively, left-side bending (F=0.134, P=0.717) after 1 week, right rotation (F=0.294, P=0.592) after 1 week and left rotation (F=0.512, P=0.480 and F=0.773, P=0.387) after 1 and 6 weeks of treatment, respectively. The experimental group shows improvement in flexion, left-side bending and right rotation by the end of treatment more than the control group; in addition both groups show similar improvements in all CROM either after 1 week or by the end of treatment (Table 2).

Discussion

The results of the current study have shown that patients with MNP in both groups experienced statistically significant improvements in pain level,

Table 2 Results of comparison of the outcome measures in both groups and between groups

	Experimental group (*N*=30) (mean ±SD)	Control group (*N*=30) (mean ±SD)	MD (95% CI) (lower limit, upper limit)	*P* value
VAS				
Baseline	6.66±1.8[a]	6.5±0.45[a]	0.13 (–1.18, 1.45)	0.837
After 1 week	4.26±1.2[b]	5.33±1.04[a]	1.1 (–1.9, 0.21)	0.016
After 6 weeks	1.5±1.4[c]	1.4±1.3[b]	0.1 (0.92, 1.1)	0.892
P value	<0.001	<0.001		
NDI				
Baseline	42.33±16.78[a]	44.1±13.87[a]	1.77 (9.75, 13.29)	0.755
After 1 week	31.6±12.96[b]	42.2±13.1[a]	10.6 (0.85, 20.3)	0.034
After 6 weeks	19.1±13.13[c]	21.45±8.7[b]	2.36 (5.9, 10.7)	0.567
P value	<0.001	<0.001		
Cervical flexion				
Baseline	32.46±5[a]	34.4±3.85[a]	1.93 (5.28, 1.7)	0.248
After 1 week	35.26±4.02[b]	34.4±3.87[a]	0.86 (2.1, 3.8)	0.553
After 6 weeks	44.6±0.98[c]	42.46±3.22[b]	2.13 (0.35, 3.9)	0.021
P value	<0.001	<0.001		
Cervical extension				
Baseline	36.8±6.46[a]	39.26±4.3[a]	2.46 (6.57, 1.6)	0.229
After 1 week	39.2±5.5[b]	39.26±4.46[a]	0.1 (3.8, 3.68)	0.971
After 6 weeks	47.3±5.1[c]	46.86±4.86[b]	0.46 (3.24, 4.17)	0.799
P value	<0.001	<0.001		
Cervical right-side bending				
Baseline	32.9±5.1[a]	35.1±2.6[a]	2.13 (5.18, 0.91)	0.163
After 1 week	34.5±4.7[b]	34.86±2.35[a]	0.33 (3.13, 2.47)	0.809
After 6 weeks	42.46±3.7[c]	40.5±3.58[b]	1.93 (4.66, 0.79)	0.157
P value	<0.001	<0.001		
Cervical left-side bending				
Baseline	33.3±3.8[a]	36±3.4[a]	2.66 (5.37, 0.04)	0.053
After 1 week	35.66±2.9[b]	35.1±3[a]	0.4 (2.63, 1.8)	0.717
After 6 weeks	43.66±2.7[c]	41.2±1.8[b]	2.47 (0.7, 4.2)	0.007
P value	<0.001	<0.001		
Cervical rotation to the right side				
Baseline	59.93±7.1[a]	63.3±6.78[a]	3.4 (8.58, 1.7)	0.190
After 1 week	62.86±5.78[b]	64±5.78[a]	1.13 (5.42, 3.15)	0.592
After 6 weeks	72.8±2.1[c]	70.7±2.6[b]	2.1 (0.29, 3.84)	0.024
P value	<0.001	<0.001		
Cervical rotation to the left side				
Baseline	60.53±4.89[a]	64±5.8[a]	3.47 (7.48, 0.55)	0.088
After 1 week	63±5.5[b]	64.46±5.68[a]	1.47 (2.73, 5.66)	0.480
After 6 weeks	70.86±6.4[c]	72.46±2.9[b]	1.6 (2.13, 5.32)	0.387
P value	<0.001	<0.001		

Different superscripts in the same column are statistically significantly different. CI: confidence interval; MD, mean difference; NDI, neck disability index; VAS: visual analog scale. *P* value: significance level. SD: Standard deviation, N: number,

NDI, and CROM after 6 weeks of treatment. However, the experimental group exhibited statistically significant greater improvements in neck pain and NDI after 1 week of the application of KT when compared with the control group that received the exercise program only.

The finding of the current study might be attributed to the positive effect of KT through increasing local circulation, reducing local edema, facilitating the targeted muscles, providing a positional stimulus to the skin, muscles, or fascial structures, providing proper afferent input to the central nervous system [6].

Stimulation of cutaneous mechanoreceptors through skin stretching gives another explanation for the acute effect of KT. This sense of stretching is thought to enhance signal information for joint position or joint movement [28]. Additional clarification of the current findings was the tape tension that provides afferent stimuli, which facilitates pain-inhibitory mechanisms that reduce the patients' pain levels (gate control theory) [28]. Moreover, the immediate effect of KT may be attributed to the stimulation of Golgi receptors which in turn decrease the muscle spasm [6].

Additionally, it is possible that the tape decreased pain by the inhibitory mechanisms as fear of movement is associated with pain intensity in patients with neck pain; it may be possible that the application of KT provides a proper sensory feedback to the patients, decreases fear of movement, thus improving neck pain and ROM. Moreover, KT may improve ROM and functional ability through providing support for the spinal segments of the cervical region [12,29]. Reduction in pain could also explain the greater ROM and the greater performance of the cervical muscles on NDI [30].

The present finding was consistent with the study conducted by Kavlak *et al.* [31] who concluded that after 15 sessions of therapy, adding KT to classic physical therapy program (that include ultrasound, interferential current, hot packs, and massage) was efficient in decreasing pain, increasing ROM, and improving NDI; however, no difference was observed between the groups by the end of the treatment. While in another study performed by Ali *et al.* [13], the authors reported that KT and therapeutic exercise have an effect on pain, NDI, and CROM after a treatment program consisted of 12 sessions in patients with MNP, and there was a significant difference between both groups in favor of the KT group.

The current study was supported by the finding of González *et al.* [12]; they showed a significant improvement of neck pain and CROM following short-term (immediately after and after 24 h) application of the KT, on acute whiplash disorders in comparison to sham tape. In addition, the findings of the current study are similar to those previously reported by Dawood *et al.* [3] as they concluded that application of KT had a beneficial effect on pain level and NDI more than exercise alone. On the other hand, the finding of Sanjay *et al.* [11] was inconsistent with the results of the present finding as patients received KT and exercise improved in their pain intensity, ROM, and NDI more than exercise alone after 4 weeks of treatment.

There are certain limitations to this study; the placebo effect was not investigated to find influence of sham taping with exercises. Moreover, it is not known whether the improvements in pain, functional abilities, and CROM that were observed following 6 weeks of KT and exercise intervention would be maintained in the long term. Further studies should be conducted to evaluate the long-term effect of KT. Additionally, further studies are necessary to find the effect of combination of KT with other interventions on pain, CROM, functional disabilities, proprioception, and quality of life on MNP, and on other cervical disorders.

Conclusion

It was concluded that the KT combined with exercises was more effective than exercises alone in improving the pain level, NDI, after 1 week of intervention. However, there was no difference between both groups in the improvement of pain level, NDI, and CROM after 6 weeks of treatment. KT is an adjunct modality that could be used in combination with exercises in the treatment of patients with chronic MNP for better outcomes.

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Conflicts of interest

There are no conflicts of interest.

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