EFFECT OF KINESIO TAPING ON THE NEUROLOGICAL REHABILITATION PROCESS IN PATIENTS WITH HEMIPLEGIC SHOULDERS

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Abstract
Introduction/Objective: This study aimed to evaluate the efficacy of applying kinesio tape to the shoulder area to relieve hemiplegic shoulder pain and improve upper extremity function in patients undergoing neurological rehabilitation.

Method: This study included 69 patients aged 18 years and over who were hospitalized for neurological rehabilitation following the diagnosis of post-stroke hemiplegia and experienced shoulder pain and functional difficulties. The patients were divided into two groups: control (n=30) and kinesio tape (n=39). Blue kinesio tape was applied to the intervention group once a week, four times, leaving the tape on for seven days. The Fugl-Meyer Assessment for Upper Extremity scale and the Visual Analog Scale pain scores of the patients were recorded at the beginning of the study and the end of the first month.

Results: There was no significant difference between the groups’ demographic, radiological, and clinical evaluations (p>0.05). Significant improvements were detected in both groups’ Fugl-Meyer Assessment for Upper Extremity scale and Visual Analog Scale scores, significantly greater in the kinesio tape group (p<0.05).

Conclusion: Kinesio tape, applied in addition to the neurological rehabilitation program, can reduce shoulder pain, increase upper extremity functions, and increase patients’ adherence to the neurological rehabilitation process in patients diagnosed with a stroke. Comprehensive, randomized, and controlled studies on this subject are needed.

Keywords: stroke; kinesio tape; disability evaluation; pain.

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Key Messages for Research and Practice

• The inclusion of kinesio taping in the neurological rehabilitation course for post-stroke patients with hemiplegic shoulder pain resulted in a notable decrease in pain levels and significant improvement in upper extremity function.

• These findings indicate that kinesio taping can be a beneficial adjunct therapy during the initial phases of stroke rehabilitation, potentially expediting the recovery process and facilitating patients’ adjustment to daily activities.
Introduction

Stroke, one of the most common causes of disability in developed countries, ranks first among adult neurological diseases. Hemiplegic shoulder discomfort can be observed as a complication in 16-84% of stroke cases [1]. Among the frequently reported etiological factors of the hemiplegic shoulder are glenohumeral subluxation, increased spasticity, loss of strength in the shoulder girdle muscles, shoulder-hand syndrome, adhesive capsulitis in the shoulder girdle, bursitis, tendinitis, thalamic syndrome, and neglect syndrome [2].

Shoulder pain and restricted range of motion observed in hemiplegic patients continue to be severe symptoms that negatively impact patients’ ability to adapt to the rehabilitation process. Consequently, the hospital stay and neurological rehabilitation of the patients are prolonged, and their daily living activities are restricted, potentially delaying their healing process. Various interventions can be employed in treating hemiplegic shoulder, including shoulder positioning, rehabilitation practices, analgesics, local anesthetics in the presence of tendinitis, corticosteroid injections, and neural therapy [3-5].

Currently, kinesio tape (KT) application on the skin has become a practical and non-invasive solution for musculoskeletal problems. KT was invented in 1973 by Dr. Kenzo Kase, a Japanese chiropractor and acupuncturist, as a method that supports joints and muscles by preserving the joint range of motion, supporting the body’s natural healing process. It has properties and thickness similar to the epidermis of the skin. It consists of polymer elastic fibers wrapped in 100% cotton fibers and does not contain latex. It stretches by 55-60% in length and is activated by heat. Recent studies have shown that the KT application supports controlling pain, inflammation, and edema and can increase neuromuscular activity. However, there are no established guidelines on this subject [6].

This study aimed to investigate the efficacy of the KT application on the shoulder area in relieving hemiplegic shoulder pain and improving upper extremity function in stroke patients. The purpose was to shorten the length of hospital stay for neurological rehabilitation and increase patients’ adaptation to daily life activities and society.

Material and method

Study population and sample

This study examined patients’ data in a rehabilitation program in the Department of Physical Therapy and Rehabilitation of the University of Health Sciences Adana City Training and Research Hospital from April 1 through June 1, 2022. For sample calculation, the study conducted by Huang et al. in Taiwan in 2016 was taken as a reference [7]. In the reference article, the required sample size was calculated with the G Power 3.1 program using the pre-and post-treatment total Fugl-Meyer Assessment for Upper Extremity (FMA-UE) scale scores of the experimental and control groups [8]. Accordingly, the sample size required for the current study was found to be at least 26 for each group by choosing a power of .80 and significance of .05. Therefore, the files of a total of 69 patients that met the criteria, 39 from the experimental group and 30 from the control group, were included in the sample.

Data collection tools

The study included patients aged over 18 who were treated as inpatients at the department of physical therapy and rehabilitation with the diagnosis of hemiplegia within the last six months following a stroke attack. Pregnant and breastfeeding patients, patients with a history of cancer, those with acute infections, and those with a history of shoulder surgery were excluded from the study. The age, gender, weight, height, and accompanying diseases of the patients were recorded. Sixty-nine patients were included in the sample. In addition to implementing the routine neurological rehabilitation program, shoulder KT was applied to the intervention group (n = 39) by the physical therapy and rehabilitation specialist physician in charge of the service four times at seven-day intervals. The routine neurological rehabilitation program was followed for the control group (n = 30), with no additional intervention being made.

The KT applied to the intervention group (Kinesio Tex Gold 5 cm x 5 m, USA) has properties similar to the skin’s epidermis and consists of 100% cotton fibers. In recent years, it has been frequently utilized to reduce pain, inflammation, and edema in neuromuscular system diseases [6]. The KT preparation was tailored to each patient, and the tape was applied to dry and clean skin using the fascia correction technique by creating 25% tension only on the arms of the Y strip from the deltoid insertion to its origin and from the supraspinatus...
muscle origin to its insertion. The application was performed by the same physical therapy and rehabilitation physician once a week for four weeks, leaving the tape on the skin for seven days [9] (Figure 1,2).

All patients underwent a neurological rehabilitation program, including joint range-of-motion, stretching, strengthening, and correct positioning training on the hemiplegic shoulder for 30 minutes a day, accompanied by a physiotherapist.

Shoulder pain was evaluated with the Visual Analog Scale (VAS). Sensorimotor changes were assessed with the FMA-UE scale before, at the end, and one month after the KT application.

In the VAS pain assessment, each patient is asked to mark the severity of pain on a 0-10-cm line, with «no pain» at one end and «the most unbearable pain» at the other end [10].

FMA-UE is a functional assessment scale that includes upper extremity muscle strength, movement control, and reflex activity in post-stroke patients and is used to monitor recovery. It consists of a total of 33 items. Each item is assigned a score from 0 to 2, depending on the patient’s performance, with scores 0, 1, and 2 representing no, partial, and full performance of the stated action. The maximum motor score for the upper extremity is 66 [11].

Statistical analysis

IBM SPSS Statistics version 25.0 (IBM, Armonk, NY, USA) was used to analyze the data. The descriptive data analysis expressed frequency distributions as numbers and percentages. The Kolmogorov-Smirnov test was performed to evaluate normality distribution and mean. Standard deviation values were obtained for the data conformed to the normal distribution. In contrast, median and interquartile range values were specified for those not complying with the normal distribution. The independent-sample t-test was employed to analyze normally distributed data, and the Mann-Whitney U and Wilcoxon signed-rank tests were used to analyze data without a normal distribution. The chi-square test was conducted to analyze categorical data. The effect size of the intervention was calculated using the following formula [12]:

\[ r = \frac{Z}{\sqrt{N_{\text{pairs}}}} \]

[0.1 ≤ r <0.3 small, 0.3 ≤ r <0.5 medium, and 0.5 ≤] large effect

A p-value of <.05 was considered statistically significant.

Ethical considerations

The study was approved by the Ethics Committee of Adana City Hospital Training and Research Hospital (date: March 10, 2022, number: 1831) and conducted in accordance with the principles of the Declaration of Helsinki.

Results

The files of a total of 69 patients, 30 from the control group and 39 from the KT group, were included in the study. The participants’ ages ranged from 25 to 93 years. Of the participants, 50.7% were men and 49.3% were women. An additional chronic disease was present in 73.9% of the patients.
Spasticity started in the upper extremity in 44.9% of the patients, while the remaining cases were flaccid. There were no significant differences in the sociodemographic and disease characteristics of the two groups (Table 1) (p>0.05).

The comparison of the two groups in terms of the scale scores revealed no significant differences, except for the VAS pain score evaluated before treatment. The pre-treatment VAS pain score was significantly higher in the KT group than in the control group (p = .008). The intragroup comparison of the groups showed significant decreases in the VAS pain scores evaluated after treatment in both groups (p = .001 for the control group and p < .001 for the control group). The effect size of the treatment was medium (0.414) in the control group and large (0.591) in the KT group. The initial VAS pain score was determined to be significantly higher among the patients diagnosed with spasticity (p = .038).

According to the intragroup comparison of the FMA-UE scale scores, there were significant increases in the post-treatment sitting position, wrist, hand, coordination and speed, and total scores of the KT group.

Table 2 presents the p values for the intragroup and intergroup comparisons of the VAS and FMA-UE scores and the effect size values of the treatments applied.

### Discussion

This study found that adding KT application to neurological rehabilitation positively affected the healing process in treating post-stroke hemiplegic shoulder pain and shoulder dysfunction. Although the pain-reducing mechanisms of KT remain clear, it is widely accepted that this application reduces pain by increasing blood circulation and lymphatic drainage, diminishing edema in the affected area, and reducing the pressure on subcutaneous nociceptors [13,14]. In a study conducted by Frassanito et al., extracorporeal shock wave therapy (ESWT) alone and in combination with KT were evaluated in terms of their efficacy in the treatment of rotator cuff calcific tendinopathy, and it was reported that despite improvement in the pain and functional status of both groups, the combined treatment was found to be more effective [15]. In another double-blind, placebo-controlled study evaluating patients with rotator cuff syndrome, no significant difference was found between the KT and placebo patch groups [16]. Although many studies investigate the effect of KT on post-stroke shoulder pain and functional loss, its efficacy in the treatment of shoulder pain remains controversial. In the current study, the VAS scores significantly decreased in the control group that only received neurological rehabilitation and in the intervention group in which the KT application was added to neurological rehabilitation for four weeks.

### Table 1. Demographic and Disease Characteristics of the Groups

<table>
<thead>
<tr>
<th></th>
<th>Control group (n = 30)</th>
<th>KT Group (n = 39)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), X ± SD</td>
<td>64.8 ± 14.3</td>
<td>62.1 ± 14.8</td>
<td>.440a</td>
</tr>
<tr>
<td>BMI, X ± SD</td>
<td>27.7 ± 2.7</td>
<td>28.5 ± 4.4</td>
<td>.364a</td>
</tr>
<tr>
<td>Sex, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15 (50.0)</td>
<td>20 (51.3)</td>
<td>&gt;.999b</td>
</tr>
<tr>
<td>Female</td>
<td>15 (50.0)</td>
<td>19 (48.7)</td>
<td></td>
</tr>
<tr>
<td>Occupation, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>11 (36.7)</td>
<td>13 (33.3)</td>
<td>.980b</td>
</tr>
<tr>
<td>Housewife</td>
<td>14 (46.7)</td>
<td>19 (48.7)</td>
<td></td>
</tr>
<tr>
<td>Civil servant</td>
<td>3 (10.0)</td>
<td>3 (7.7)</td>
<td></td>
</tr>
<tr>
<td>Self-employed</td>
<td>2 (6.6)</td>
<td>4 (10.3)</td>
<td></td>
</tr>
<tr>
<td>Additional disease, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>9 (30.0)</td>
<td>9 (23.1)</td>
<td>.709b</td>
</tr>
<tr>
<td>+</td>
<td>21 (70.0)</td>
<td>30 (76.9)</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>25 (83.3)</td>
<td>32 (82.1)</td>
<td>&gt;.999b</td>
</tr>
<tr>
<td>+</td>
<td>5 (16.7)</td>
<td>7 (17.9)</td>
<td></td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>10 (33.3)</td>
<td>11 (28.2)</td>
<td>.845b</td>
</tr>
<tr>
<td>+</td>
<td>20 (66.7)</td>
<td>28 (71.8)</td>
<td></td>
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<tr>
<td>Spasticity, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>20 (66.7)</td>
<td>18 (46.2)</td>
<td>.146b</td>
</tr>
<tr>
<td>+</td>
<td>10 (33.3)</td>
<td>21 (53.8)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30 (100.0)</td>
<td>39 (100.0)</td>
<td></td>
</tr>
</tbody>
</table>

*Independent-samples t-test, aChi-square test
KT: Kinesio Tape, X ± SD: Mean ± Standard Deviation, BMI: Body Mass Index
shoulder pain and functional activity. Huang et al. reported that the KT application on the forearm and dorsal hand added to the neurological rehabilitation program in patients with subacute stroke might be beneficial in reducing spasticity and improving motor performance in the affected hand, according to the follow-up results of the FMA-UE scale Brunnstrom recovery stage evaluation [19]. In another study, following the addition of KT and sham tape to the neurological rehabilitation program for three weeks, Huang et al. reported a more remarkable improvement in shoulder pain, the disability index, and the pain-free passive range of motion of the affected shoulder in the KT group, while there were no significant differences between the two groups in terms of the shoulder ultrasound findings [20]. In a study in which KT was applied to the forearm extensor muscle region three times in the hemiplegic upper extremity in patients diagnosed within the past year, there were increases in the hand functional index, the Minnesota Manual Dexterity test scores, and hand grip strength of the patients after treatment [21].

The effect size of treatment was found to be medium in the control group and large in the KT group.

In most stroke cases, the functional recovery of the lower extremity is faster than that of the upper extremity. In acute stroke, upper extremity motor dysfunction is observed in 80% of patients, and the recovery rate is higher within the first six months. It has been determined that motor dysfunction may be permanent in 50-60% of cases over six months, potentially decreasing patients’ quality of daily life and their adaptation to society [17,18]. This shows the importance of treatments added to the neurological rehabilitation process, especially within the first six months, to accelerate upper extremity recovery. The KT application has been frequently preferred in recent years as a procedure that can be easily applied and has fewer side effects in patients being followed up with a diagnosis of post-stroke hemiplegia. Despite the availability of research on the effect of the KT application on the musculoskeletal system, only a limited number of studies have shown its effect on hemiplegic shoulder pain and functional activity. Huang et al. reported that the KT application on the forearm and dorsal hand added to the neurological rehabilitation program in patients with subacute stroke might be beneficial in reducing spasticity and improving motor performance in the affected hand, according to the follow-up results of the FMA-UE scale Brunnstrom recovery stage evaluation [19]. In another study, following the addition of KT and sham tape to the neurological rehabilitation program for three weeks, Huang et al. reported a more remarkable improvement in shoulder pain, the disability index, and the pain-free passive range of motion of the affected shoulder in the KT group, while there were no significant differences between the two groups in terms of the shoulder ultrasound findings [20]. In a study in which KT was applied to the forearm extensor muscle region three times in the hemiplegic upper extremity in patients diagnosed within the past year, there were increases in the hand functional index, the Minnesota Manual Dexterity test scores, and hand grip strength of the patients after treatment [21].
In a randomized controlled study, Hsieh et al. found that the KT application added to modified constraint-induced movement therapy for six weeks in stroke patients with hemiplegia for three to 12 months provided greater improvement in upper extremity function and spasticity [22]. In a review of 12 articles, the authors found that the KT application effectively reduced pain and improved shoulder subluxation and upper extremity function and could be recommended for treatment [23]. In our study, KT was applied to the shoulder area once a week for seven days for four weeks in hospitalized patients diagnosed with hemiplegia within the last six months and undergoing routine neurological rehabilitation. After KT treatment, in addition to a decrease in VAS pain scores, a significant improvement was detected in the FMA-UE sitting position, wrist, hand, and total scores that evaluate functional capacity, and the effect size of the KT treatment was found to be medium. In addition, significant improvement was detected in both groups’ FMA-UE coordination and speed scores, with the effect size of KT being small.

There are a few studies in the literature in which KT was applied to the hemiplegic shoulder, but we did not find any research that detailed the results according to the four sections of the FMA-UE scale. Therefore, our study on this subject is original.

**Limitations of the study**

This study has several limitations that need to be addressed. First, the study included patients who had a stroke within the last six months; therefore, no conclusion can be drawn about those in the chronic period. Second, the short-term results of the KT application were investigated. It is recommended to conduct further studies with multiple patient groups, specifically including patients who have been hemiplegic for more than six months, and over a longer follow-up period.

**Conclusions**

The results of this study showed that the KT application added to the neurological rehabilitation program for hemiplegic upper extremities reduced the patients’ pain levels and increased their motor function. Therefore, it was deemed beneficial to incorporate this application into the neurological rehabilitation program for these patients.

**DISCLOSURES**

None

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None

**CONFLICT OF INTEREST**

The author declares no conflicts of interest regarding the publication of this article

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