Effects of Kinesiotaping on shoulder pain as a single therapy or in combination with physiotherapy: A quasi-experimental study

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Abstract: Shoulder pain is one of the most common musculoskeletal injuries; there are different methods employed in its treatment, among them is Kinesiotaping. We evaluated the effects of Kinesiotaping and its variation according to the time of application on pain, range of motion and strength in people with shoulder pain, alone or as a complement to physical therapy. To do this, we conducted a quasi-experimental study, on 50 patients with shoulder pain, who were assigned to 4 intervention groups for 11 days: 1-Kinesiotaping (n = 12), 2-Physiotherapy (n = 13), 3-Kinesiotaping plus Physiotherapy (n = 12) and 4-Physiotherapy plus Kinesiotaping (n = 13). We performed an analysis of differences-in-differences using linear regression, finding a pain reduction of 65.2 mm (95%CI: −81.9; −48.5) in visual analog scale for kinesiotaping group. Physiotherapy and Kinesiotaping group obtained a better increase in post-intervention strength (mean of 1.1 points; 95%CI: 0.5; 1.8) on the Oxford scale. For the range of motion, the kinesiotaping and, the physiotherapy plus kinesiotaping groups achieved the greatest increase in post-intervention measurement, 22°(95%CI: 12.1; 31.9) and 15.6°(95%CI: 6.1; 25.2) respectively. In our concept, Kinesiotaping alone can be used to reduce pain and increase mobility and when used after physiotherapy as a complement, it can obtain majors results in strength and range of motion.

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Diana Carolina Tiga Loza is a nurse, with a master’s degree and a doctorate in epidemiology, leader of the research group in health, rehabilitation and work (SARET) of the Manuela Beltrán University-Bucaramanga Section. This research group has sought to generate solutions in the field of health that impact the national and international contexts supported by the generation of new knowledge. The research carried out is carried out in an interdisciplinary manner, where one of the lines of research is human body movement, recovery and rehabilitation. The research group has carried out some research and publications on kinesiotaping and in turn, has trained physiotherapists in the techniques of applying this bandage.

PUBLIC INTERSET STATEMENT
Kinesiotaping is a type of bandage that adheres to the skin, is easy to apply, inexpensive and has been used not only in sports but also in the treatment of common injuries such as shoulder pain, with favorable results in pain and strength and movement. This study evaluated the effect of kinesiotaping on pain, movement, and strength in 50 patients diagnosed with shoulder pain who were assigned one of the four different application sequences and combinations. In one group only kinesiotaping was used, another group was treated with physiotherapy only and two groups were treated with a combination of kinesiotaping and physiotherapy but with a different order of application. The results found are significant for the reduction of pain when the kinesiotaping tape is applied alone and when used as a complement to physical therapy, it can increase the results in mobility and joint strength in patients with shoulder pain.
Subjects: Orthopedics; Assistive Technology; Physiotherapy

Keywords: Kinesiotaping; pain; painful shoulder; range of motion and strength

1. Introduction
The World Health Organization (1998), mentions that musculoskeletal disorders are part of conditions defined as “work-related disorders” that can be caused by occupational factors. These disorders include a group of diagnoses that encompass alterations in structures such as muscles, tendons, tendon sheaths, nerve entrapments, joint and neurovascular alterations, which can give rise to the painful shoulder.

According to Heuberer et al. (2017), biomechanical alterations in the shoulder cause different pathologies and, in combination with extrinsic/intrinsic factors, lead to progressive degeneration of the tendons; the foregoing, implies that the majority of shoulder pathologies are multifactorial. The prevalence of shoulder pain is between 6.9% and 26% (Luime et al., 2004), and in Europe, it has been observed that for every 1000 patients who visit the general practitioner, 11 seek medical help for shoulder pain (World Health Organization, 1998).

This pathology is frequently treated with different methods such as non-pharmacological (physiotherapy), complementary therapies (acupuncture, kinesiotaping) and pharmacological (analgesics, anti-inflammatory drugs), all this in order to reduce pain and improve functionality (Djordjevic et al., 2012).

Several studies have described favorable results regarding the effects of kinesiotaping (Bhashyam et al., 2018; Saracoglu et al., 2018); for instance, a decrease in pain, an improvement in mobility and functionality has been reported when comparing kinesiotaping with placebo or as complement to conventional and laser therapies in shoulder pathologies (Djordjevic et al., 2012; DO Kaya et al., 2014; E Kaya et al., 2011; Thelen et al., 2008); however, it has not been studied whether the effect on the application of kinesiotaping varies according to the time of application; for example, before or after a physiotherapy protocol or as a single therapy compared to physiotherapy or combined therapies.

Therefore, the objective of this study was to evaluate the effects of kinesiotaping in pain, muscle strength and range of motion, either as a single therapy or in combination with physiotherapy, in patients with shoulder pain.

2. Materials and methods
A quasi-experimental, pre-post parallel and simple blind study was conducted. During April to July 2016, people with shoulder pain, in rehabilitation centers in Bucaramanga, Colombia, or who were contacted through social networks, were invited to participate. The inclusion criteria were, being diagnosed with shoulder pain, being between 20 and 50 years old, having no shoulder surgery, not having serious chronic diseases including rheumatoid diseases, or recent skin scars in the region to treat, and not being pregnant due to the increase in physiological laxity of the joints.

Participants were split into four intervention groups; 1-Kinesiotaping, 2-Physiotherapy, 3-Kinesiotaping plus Physiotherapy and, 4-Physiotherapy plus Kinesiotaping. Each group was treated for eleven consecutive days with the intervention and the combined groups were treated the first 5 days with one intervention and the remaining days with the following intervention. The interventions were made as follows:

2.1. Physiotherapy (PT)
1-Application of a wet heat on the shoulder for 20 minutes simultaneously with TENS conventional mode with modulated current, 2-Sedation massage for 10 minutes, 3-Proprioceptive neuromuscular facilitation with the rhythmic stabilization technique directed to scapular waist performed in 8 repetitions.
2.2. Kinesiotaping (KT)
Application according to Kase et al. (2003) techniques, using Kinesio®Tex Gold™ (Tokyo, Japan). The space enlargement and asterisk techniques were applied in the anterior area of the treated shoulder; also, two “I” strips were placed, one with the mechanical correction technique on the lateral shoulder area and another with ligament technique on the acromio-coracoid ligament; the bandage was removed on the fifth or sixth day and a new placement was performed regardless of the state in which the bandage was found.

Pre and post evaluations in pain, range of motion and muscle strength were made by a blinded physiotherapist as follows:

2.3. Pain
The visual analogue scale (VAS) was used to evaluate the perception of pain at rest, palpation and movement, by marking with an X on a 100 mm ruler (Jensen, 2003).

2.4. Range of motion
Passive manual goniometry in degrees was measured, in the gleno-humeral joint, using a basic goniometer (Kapandji, 2010).

2.5. Muscle strength
Assessment was made in the main muscles for movements of flexion, extension, abduction, internal and external rotations, in the compromised shoulder, using the Oxford scale to score from 0 to 5, where 0 represents the absence of movement and 5 means movement in the whole range of movement against gravity (Clarkson, 2003).

The description of the categorical variables was made in absolute and relative frequencies (percentages); the continuous variables were summarized by measures of central tendency and dispersion (mean and standard deviation). To identify differences in the characteristics of onset, according to the groups evaluated, Fisher and ANOVA tests were used, for categorical and continuous variables, respectively.

The changes between pre-post measurement were presented as an average delta (final-initial score) and 95% confidence interval; the estimations were made by difference-in-differences analysis, based on linear regression. The analyses were performed at STATA 16-SE.

3. Findings
A total of 68 patients were assigned in the study groups, excluding 18 participants because they only had the initial measurement, for a final sample of 50 people, divided in: 1-KT(n = 12), 2-PT(n = 13), 3-KT+PT (n = 12) and 4-PT+KT(n = 13). Due to the losses in the follow-up, the power of the sample was estimated, taking into account the lowest effect obtained, a power of 79.23% was found.

The baseline characteristics of the participants are presented in Table 1, there were no significant differences in the baseline characteristics, except for the performance of repetitive movements (p = 0.02) and ranges of extension and external rotation movement (p = 0.008 and p = 0.045).

The changes achieved in pain, strength and ranges of motion in the different groups after the interventions are described in Table 2. All interventions obtained a significant reduction in pain at rest, palpation and movement, except the PT group for pain at rest. The greatest pain reduction was achieved in the KT group, decreasing by 65.2 mm on average in VAS (95%CI: -81.9; -48.5). The KT+PT group achieved the greatest reduction in pain at rest and palpation (33.3 mm and 32.9 mm, respectively). The mean pain reduction in all groups and for all types was 41.3 mm.
Table 1. Baseline characteristics of the participants, according to the intervention group-Bucaramanga- Colombia, 2016

| Characteristics       | PT          | KT          | PT+KT       | KT+PT       | All groups   | p     |
|-----------------------|-------------|-------------|-------------|-------------|--------------|-------|
|                       | n = 13      | n = 12      | n = 13      | n = 12      | n = 50       |       |
| Sex, n(%)             |             |             |             |             |              |       |
| Female                | 8.0(61.5)   | 4.0(33.3)   | 9.0(69.2)   | 7.0(58.3)   | 28.0(56)     | 0.333 |
| Age, mean(SD)         | 51.1(13.4)  | 44.2(16.9)  | 43.9(10.2)  | 43.0(17)    | 45.6(14.5)   | 0.836 |
| Pain, mean(SD)        |             |             |             |             |              |       |
| At rest               | 16.2(17.1)  | 35.8(31.5)  | 34.6(41.0)  | 41.7(40.9)  | 31.8(34.3)   | 0.270 |
| At palpation          | 37.7(21.3)  | 37.5(24.9)  | 46.9(38.2)  | 52.9(31.7)  | 43.7(29.6)   | 0.509 |
| At movement           | 60.4(24.7)  | 83.5(17.7)  | 60.8(25.0)  | 79.2(18.8)  | 70.5(23.8)   | 0.509 |
| Pain, total-mean      | 38.1(17.2)  | 52.3(18.9)  | 47.4(27.9)  | 57.9(19.3)  | 48.7(21.9)   | 0.135 |
| Strength, mean(SD)    |             |             |             |             |              |       |
| Anterior deltoid      | 3.5(0.7)    | 2.8(1.6)    | 3.2(1.1)    | 3.7(1.1)    | 3.3(1.2)     | 0.292 |
| Posterior deltoid     | 3.6(0.8)    | 3.4(1.5)    | 3.5(1.0)    | 3.9(0.8)    | 3.6(1.0)     | 0.683 |
| Medial deltoid        | 3.5(0.8)    | 2.8(1.3)    | 3.3(1.1)    | 3.3(0.9)    | 3.3(1.0)     | 0.401 |
| Teres major           | 3.5(0.9)    | 3.3(1.4)    | 3.4(1.0)    | 4.0(0.7)    | 3.5(1.1)     | 0.331 |
| Subscapularis         | 3.3(0.8)    | 3.3(1.3)    | 3.2(1.2)    | 3.6(0.8)    | 3.4(1.0)     | 0.846 |
| Teres minor           | 3.8(0.9)    | 3.2(1.3)    | 3.4(1.2)    | 3.8(0.6)    | 3.6(1.1)     | 0.289 |
| Strength, total-mean  | 3.6(0.5)    | 3.1(1.3)    | 3.3(1.0)    | 3.7(0.6)    | 3.4(0.9)     | 0.439 |
| Range of motion, mean(SD) |     |             |             |             |              |       |
| Flexion               | 147.3(35)   | 131.7(36.9) | 154.6(42.7) | 153.3(46.8) | 146.9(40.3)  | 0.489 |
| Extension             | 49.2(11.9)  | 45.0(9.3)   | 51.2(9.2)   | 58.3(3.9)   | 50.9(10.0)   | 0.008 |
| Abduction             | 136.5(46.3) | 117.9(34.6) | 144.6(55.8) | 144.2(28.7) | 143(40.1)    | 0.323 |
| Internal rotation     | 46.9(26.8)  | 53.4(12.9)  | 54.6(25.4)  | 61.3(23.5)  | 53.9(22.8)   | 0.491 |
| External rotation     | 60.8(34.8)  | 78.3(19.5)  | 78.5(28.2)  | 90.0(0.0)   | 76.6(26.3)   | 0.041 |
| Range of motion, total-mean | 88.2(26.8) | 85.3(16.7)  | 96.7(26.0)  | 101.4(15.8) | 92.9(22.4)   | 0.256 |

*Pain in millimeters by visual analog scale (VAS)

*Muscle strength by Oxford scale

*Range of motion in degrees

*Fisher exact test

*Analysis of Variance (ANOVA)
Table 2. Change achieved after the intervention in the different groups. Bucaramanga- Colombia, 2016

| Characteristics          | PT          | KT          | PT + KT     | KT + PT     |
|--------------------------|-------------|-------------|-------------|-------------|
|                          | n = 13      | n = 12      | n = 13      | n = 12      |
| **Pain, mean (95% CI)**  |             |             |             |             |
| At rest                  | -12.6 (-32.3; 7.1) | -31.3 (-51.7; 10.8)* | -29.2 (-48.9; 9.6) | -33.3 (-53.8; 12.9)** |
| At palpation             | -24.6 (-44.2; 5.0)* | -29.2 (-49.6; 8.7)* | -28.8 (-48.5; 9.2)* | -32.9 (-53.4; 12.5)** |
| At Movement              | -31.5 (-47.5; 15.4)** | -65.2 (-81.9; 48.5)** | -44.4 (-60.4; 28.3)** | -47.9 (-64.6; 31.2)** |
| Pain, total-mean         | -22.8 (-36.6; 9.1)** | -41.3 (-55.6; 27)** | -33.6 (-47.3; 19.8)** | -37.9 (-52.2; 23.6)** |
| **Strength, mean (95% CI)** |           |             |             |             |
| Anterior deltoid         | 0.5 (-0.2; 1.3) | 1.3 (0.5; 2.1)* | 1.2 (0.5; 2.0)** | 1.3 (0.5; 2.1)* |
| Posterior deltoid        | 1.0 (0.3; 1.7)* | 0.8 (0.1; 1.5)* | 0.9 (0.2; 1.6)* | 0.9 (0.2; 1.6)* |
| Medial deltoid           | 0.5 (-0.3; 1.3) | 1.2 (0.3; 2.0)* | 0.9 (0.1; 1.7)* | 1.3 (0.4; 2.1)* |
| Teres major              | 0.8 (0.2; 1.5)* | 1.0 (0.3; 1.7)* | 1.2 (0.5; 1.8)** | 0.8 (0.1; 1.6)* |
| Subscapularis            | 0.9 (0.2; 1.6)* | 1.0 (0.3; 1.7)* | 1.2 (0.5; 1.9)** | 1.2 (0.4; 1.9)** |
| Teres minor              | 0.5 (-0.3; 1.2) | 0.8 (0.1; 1.5)* | 1.3 (0.6; 2.0)* | 0.8 (0.0; 1.5) |
| Strength, total-mean     | 0.8 (0.1; 1.4)* | 1.0 (0.3; 1.7)* | 1.1 (0.5; 1.8)** | 1.0 (0.4; 1.7)* |
| **Range of motion, mean (95% CI)** |           |             |             |             |
| Flexion                  | 18.8 (-6.8; 44.5) | 39.2 (12.5; 65.9)** | 16.2 (-9.5; 41.8) | 23.3 (-3.4; 50.0) |
| Extension                 | 4.6 (2.8; 8.1)** | 11.7 (8.1; 15.3)** | 6.2 (2.7; 9.6)** | 0.8 (-2.7; 4.4) |
| Abduction                | 18.1 (-9.5; 45.6) | 36.7 (8.0; 65.4)* | 24.6 (-2.9; 52.2) | 30.8 (2.1; 59.5)* |
| Internal Rotation         | 7.7 (-7.5; 22.8) | 16.3 (0.5; 32.0)* | 21.9 (6.8; 37.1)** | 15.8 (0.1; 31.6)* |
| External Rotation        | 21.2 (12.8; 29.5)** | 6.2 (-2.5; 15.0) | 9.2 (0.9; 17.6)* | 0.0 (-8.7; 8.7) |
| Range of motion, total-mean | 14.1 (4.5; 23.6)* | 22.0 (12.1; 31.9)** | 15.6 (6.1; 25.2)** | 14.2 (4.2; 24.1)* |

*p-value <0.05  
**p-value <0.001  
*Values adjusted by the initial measurement.
The strength improved significantly in all the groups, except for PT. The PT+KT group achieved a higher level of post-intervention strength with an average of 1.1 points (95%CI: 0.5; 1.8) on the Oxford scale and this was consistent in most of the muscles evaluated (Table 2).

The KT and PT+KT groups obtained better post-intervention results in the range of motion. On average, KT improved 22° and PT+KT 15.6°. In terms of range of motion, KT obtained better results in flexion, extension, abduction; while in internal rotation PT+KT increased the range by 21.9° (95% CI: 6.8; 37.1). PT obtained the highest recovery of the range of movement with respect to other groups in external rotation (21.2° 95%CI: 12.8; 29.5). Figure 1 describes the mean values adjusted by linear regression for pain, range of motion and pre-post intervention strength.

4. Discussion
The results of this study show improvements in pain and range of motion; with greater results for Kinesiotaping compared to other groups; however, combined therapies have a greater effect on muscle strength.

These findings are comparable with other studies. Thelen et al. (2008), reported that Kinesiotaping reduced, on the first day of application, pain at movement and improved range of motion in the painful shoulder (p = 0.005). Kaya E. et al. also performed the application of Kinesiotaping in shoulder impingement syndrome, together with a home Physiotherapy program in comparison with Physiotherapy only, decreasing the pain at rest, night pain and on movement (p < 0.01) (E Kaya et al., 2011).

Simsek et al. (2013), compared the effectiveness of Kinesiotaping together with an exercise protocol and the application of a placebo, for subacromial impingement, finding that Kinesiotaping added to an exercise program with TheraBand, decreased the intensity of pain, it also improved strength and ranges of movement after 5 days of intervention (p < 0.05). Another study by Tantawy and Kamel (2016), found after 2 weeks, an effect from Kinesiotaping in pain reduction and ranges of motion in post-mastectomy patients.
On the other hand, Subaşı et al. (2016), applied Kinesiotaping in patients with subacromial impingement syndrome together with physiotherapy, in comparison with physiotherapy plus corticosteroid injection, finding that both groups improved substantially, demonstrating that the bandage can be used as an alternative for patients to whom corticosteroid medication is ill-advised.

In relation to the clinical relevance, it is considered that a decrease of 33 mm in VAS, is a significant pain reliever (Jensen, 2003). Shakeri et al. (2013), performed the intervention with only Kinesiotaping compared to a placebo in people with shoulder impingement syndrome; decreasing pain level significantly between 2 and 3 mm (scale of 0 mm-10 mm; p < 0.001), together with improvement of the ranges of movement between 10º-19º (p < 0.001). Similarly, a review of tension taping shows that, taping for shoulder impingement may reduce pain and improve shoulder function scores, for up to 2 weeks, when used as an adjunct to physiotherapy (Bhashyam et al., 2018).

Our results point to a statistically significant improvement in strength for PT+KT group; probably, due to the use of the proprioceptive neuromuscular facilitation technique within the physiotherapy protocol (Voss & Knott, 1991), and to the pain relieve achieved with Kinesiotaping, that favored the recruitment of motor units during muscle activity. In this regard, there are conflicting results; Simsek et al. (2013) using kinesiotaping, reported an improvement in muscle strength measured with dynamometry; on the other hand, Reynard et al. (2018) did not find clinically relevant results in this terms, in postsurgical patients with rotator cuff lesion.

The therapeutic should point in the first place to pain and to restore stability, and finally increase the range of mobility, especially external rotation (Skolimowski et al., 2008). The use of KT can be useful for joint function when properly positioning a joint.

This is a quasi-experimental study without a random allocation; although, no significant differences were found between the groups at the baseline in most of the variables. It would be desirable to carry out randomized clinical trials and use measurements with greater precision. Additionally, we recommended the assessment of the cause of pain, intending to evaluate if the effect is different. Although there are alternatives with proven effect such as infiltrations, we only use non-pharmacological techniques commonly used in physiotherapy for this comparison.

5. Conclusion

Kinesiotaping as a therapy for shoulder pain may favor the reduction of pain and improve the range of motion. Additionally, its application after physiotherapy, can increase muscle strength and range of motion. The application of kinesiotaping alone obtained the greatest results in pain reduction and range of motion.

On the contrary, kinesiotaping alone did not significantly improve the level of strength; nevertheless, can enhance physiotherapy results in muscle strength.

Funding
Funding was provided by Universidad Manuela Beltrán and, all procedures were endorsed by the institutional research and ethics committee, and under resolution 8430 of 1993, which sets the standards for research in Colombia, and the Helsinki Declaration of 1975. All participants signed informed consent.

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Disclosure statement
The authors of this article declare that we have no conflicts of interest.

Ethical clearance
Premilinar findings were presented in “IV Encuentro de investigación en fisioterapia en Colombia” on 16 August 2018, and a related abstract was published.
Citation information
Cite this article as: Effects of kinesiotaping on shoulder pain as a single therapy or in combination with physiotherapy: A quasi-experimental study. Diana Carolina Tiga-Loza, Diana Cristina Marin-Ariza & Ximena Villota, Cogent Medicine (2020), 7: 1816258.

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