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Therapeutic effects of Kinesio-tape on lateral ankle instability

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Abstract
Objective: To determine the effect of kinesio taping on ankle joint pain, balance and functional performance in patients with lateral ankle instability.
Material and Methods: The study included 30 subjects with age was ranged from 18 to 35 years; they were divided into two groups:
experimental group A: This group Consisted of 15 patients with lateral ankle sprain treated by selected balance training program in form of three sessions per week for four weeks, in addition to taping the ankle joint with adhesive elastic kinesio tape.
Control group B: This group Consisted of 15 patients with lateral ankle sprain treated by selected balance training program in form of three sessions per week for four weeks, the same balance training as group (A) but without the use of kinesio tape to the ankle joint. The investigations were conducted at balance unit, in sport medicine specialized center in Nasr city. Measurements were conducted before starting the treatment as a first record and at the end of 4 weeks of treatment as second record. Exclusive criteria were subjects who had other co morbidities which affect results.
Results: when comparing the two groups (A and B) before treatment, the mean ± SD values were 2.79 ± 1.05 and 2.46 ± 0.92 respectively which indicated no significant improvement (p= 0.365), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.33 ± 0.36 and 1.9 ± 0.69 respectively which indicated a significant improvement (p= 0.011) in favor of group (A) (MD= 0.57) and % of improvement was 21.42 %.
Conclusion: it was concluded that kinesio taping had improvement on pain, balance and functional performance in patient with lateral ankle sprain.

Keywords: lateral ankle sprain, kinesio tape, balance training

1. Introduction

Lateral ankle sprains (LAS) are one of the most commonly occurring injuries amongst the general population, accounting for upwards of 20% of all joint-related injuries (Gribble *et al*., 2014) [10].

More specifically, studies have also shown that 60% of sports injuries fall under the category of sprains, luxations and ligament tears with the ankle being the most affected joint (de Noronha *et al*., 2013) [7].

Collegiate athletics, with such an inherently high rate of injury exposures, offers an ideal population to study when the primary outcome of interest is re injury. In a study conducted by Hootman *et al*. in 2007 as a summary of 16 years (1988-2004) of NCAA injury surveillance data it was found that more than 50% of injuries were to the lower extremity (Hootman *et al*., 2007) [18].

Furthermore, ankle ligament sprains were the most common injury of the included 15 sports, accounting for 15% of all reported injuries (Hootman *et al*., 2007) [18].

It has been reported that 32-74% of individuals with a previous history of LAS will suffer from residual or chronic symptoms and go on to develop chronic ankle instability (CAI). Chronic ankle instability has been classified as a condition involving ankle pain and swelling with activity, recurring episodes of "giving-way", repetitive ankle sprains and restrictions of or a failure to return to levels of previous activity (Wikstrom and Brown, 2014) [34].

To date, most research has been directed towards changes and impairments that occur as a result of CAI rather than potential predictors of the pathology. With ankle re injury being arguably the most detrimental of the various signs and symptoms involved with CAI, a valuable prediction of re-injury may give clinicians the tool necessary to better treat these injuries, in turn creating more optimal outcomes. Additionally, it would offer a guide for which individuals at a high risk of re-injury could be identified. Current literature in regards to potential predictors of re-injury is limited, with only a history of previous ankle injury proving to be significantly predictive of future re-injury (Hiller *et al*., 2008) [16].

Other risk factors that have been identified include reduced dorsiflexion range-of-motion and deficits in postural control, proprioception and functional instability (de Noronha *et al*., 2013) [7].

With CAI offering a primarily "symptom-based" presentation due to its complexity and multi-factorial nature, patient questionnaires or surveys have become a widely used tool in identifying the pathology. One such questionnaire is the Cumberland Ankle Instability Tool (CAIT). First published by Hiller in 2006 the CAIT is a 9-item, 30-point

questionnaire that is utilized without comparison to the contra lateral ankle (Hiller *et al*., 2006) [15].

Proprioception function is presumably elaborated in three ways as described in the literature. First, the information from the proprioception helps to protect the joint from excessive and injurious movement via reflex mechanism. Second, it gives information about joint stabilization during static posture. Third, it will help in performance coordination of the movement or complex movement in a precise manner (Knoop *et al*., 2011) [26].

In recent years, the use of Kinesio Tape (KT) has become increasingly popular. Kinesio tape was designed to mimic the qualities of human skin. It has roughly the same thickness as the epidermis and can be stretched between 30% and 40% of its resting length longitudinally. Kinesio Tape has several benefits, depending on the amount of stretch applied to the Tape during application to provide a positional stimulus through the skin, to create more space by lifting fascia and soft tissue above area of pain / inflammation, and to provide sensory stimulation to assist motion (Kase *et al*., 2003) [22].

Kinesio tape is a new therapeutic tool and has become increasingly popular within sporting. KT was developed in 1996 by kenzo kase. With the intention to alleviate pain (Liu *et al*., 2007) and improve healing in soft tissues (Kahanov, 2007) [38].

Among a variety of ankle stabilizer methods, taping is currently used immediately following injury and during the rehabilitation process. The purpose of taping is to prevent injuries from the onset, reduce the injury frequency rate, and minimize the severity of injuries when they do occur, by applying taping over different joints in a manner appropriate for each sport (Halseth *et al*., 2004) [11].

Among a variety of ankle taping methods, Kinesio taping has positive effects on correcting muscle function, circulation of blood, decreasing pain, repositioning subluxated joints, restoration of the function of the fascia and muscle, and improving proprioception (Lee and Lee, 2015) [27].

As with many taping mechanisms, enhanced proprioception is a perceived benefit of KT (Thelen *et al*., 2008) [32] it is proposed that cutaneous mechanoreceptors are stimulated by the stretch upon KT application which conveys information regarding joint movement and position (Riemann *et al*., 2002).

A study conducted concluded that KT provide proprioceptive feedback to achieve postural alignment in patients following stroke Jaraczewska and long (2006).

Another study indicated that the use of Kinesio Tape at a distal joint can alter proximal joint movement in subjects with functional ankle instability (De la Motte *et al*., 2009).

The growing popularity of KT can be attributed. In some respects to anecdotal support for its therapeutic benefit. However the research surrounding KT is still in its infancy and scientific evidence to support its use and effects is still being established (Thelen *et al*., 2008) [32].

Biodex Balance System (BBS) has been used to evaluate postural balance in recent years (Aydog *et al*., 2005) [1]. There is high reliability for BBS to evaluate dynamic postural balance (Karimi *et al*., 2008) [20].

In addition to assessing balance, studying dynamic postural control also adds additional demands of proprioception, range of motion, and strength while attempting to maintain an upright and steady posture (Gribble, 2003).

Wright *et al*., 2014 proposed a recalibration of the CAIT using a cut-off score of at least <25 to allow individuals membership in the CAI population.

Therefore studies on the effect of ankle taping during specific movements such as jumps or balance tasks are scarce, and its influence on sport performance is controversial (Javiera *et al*., 2008).

2. Material and Methods

This study took place at Faculty of Physical Therapy, Cairo University, Egypt and during the period between 2017 to 2018.

Data collection

This study was carried out to investigate effect of kinesio tape on balance and functional activity performance in patient with lateral ankle instability. The investigations were conducted at balance unit, in sport medicine specialized center in Nasr city.

Groups Design of the study

The study included 30 subjects selected according to the following inclusive criteria:

1. Age was ranged from 18 to 35 years.
2. All patients were diagnosed clinically as lateral ankle sprain grade one or two in there right ankle and there dominant side was right side.
3. Lateral ankle sprain had incidence ranged from two weeks up to six months post injury.

Exclusion criteria

1. Age less than 18 years or more than 35 years.
2. Any foot or lower limb with history of deformities, fractures or internal fixation.
3. Ankle surgery or injury in either side.
4. Any condition of skin diseases or allergy to adhesive tapes.
5. History of neurological disorder affecting the lower extremities, vestibular dysfunction, or balance disorder.

They were divided into two groups

(Experimental group) (A): This group Consisted of 15 patients with lateral ankle sprain treated by selected balance training program in form of three sessions per week for four weeks, in addition to taping the ankle joint with adhesive elastic kinesio tape, subjects were taped for a lateral ankle sprain in accordance to (Seda Bicici *et al*., 2012) [2].

The first strip began on the dorsum of

The foot and traveled up the anterior aspect of the ankle and lower leg ending distal to the knee approximately over the tibial tuberosity. The second strip began on the plantar surface of the foot and traveled laterally over the lateral malleolus and lateral aspect of the lower leg. This strip terminated on the proximal lower leg over the head of the fibula. The third strip passes anteriorly across the ankle medial to lateral. The final strip began on plantar surface of the foot anterior to the second strip. It proceeded laterally ending on the anteromedial aspect of the lower leg approximately one-third of the way up the leg (Figure 2).

Fig 1: Kinesio tape application to ankle

Group (B): (the control group): This group Consisted of 15 Patients with lateral ankle sprain treated by selected balance training program in form of three sessions per week for four weeks, the same balance training as group (A) but without the use of kinesio tape to the ankle joint.

Balance training program

1. Maintaining a single-leg stance on a flat surface with eyes open and closed.(fig.2)
2. Performing functional sport activities such as throwing, catching, while in single-leg stance on the board. (fig.3)
3. Maintaining double-leg stance while rotating the balance board. (fig.4)
4. Maintaining single-leg stance on balance board with eyes open and closed. (fig.5)

Each exercise was performed for duration of 30 seconds per leg, for 10 repetition and legs were alternated during a rest period of 30 seconds between repetitions. the exercise program was 3 times per week for 4 weeks.

Fig 2

Fig 3

Fig 4

Fig 5

Instrumentations

A- For evaluation

1. The Cumberland Ankle Instability Tool (CAIT).
2. The Biodex balance system**.**

B- For treatment

- Kinesio tape.
- Balance training tools (balance board).

Statistical analysis

In this study, the obtained data was recorded on the evaluation sheet.

These data was transferred into IBM card using IBM personal computer with statistical program to obtain the following statistical tools:

i) Descriptive statistics

In this study, the descriptive statistics inform of mean, and standard deviation was calculated for all patients in the two groups of the study to determine the homogeneity and central deviation.

ii) Analytic statistics

In this study, the mean, standard deviation and standard error was calculated for all variables in both groups.

Independent "T" test was used also to compare between pre test and post test in each group.

Comparison was applied by student T test to compare between the independent means.

A value of $p<0.05$ was considered statistically significant

3. Results

3.1 Comparing the mean values of anterior / posterior stability index between the two groups:

When comparing the two groups (A and B) before treatment, the mean ± SD values were 2.79 ± 1.05 and 2.46 ± 0.92 respectively which indicated no significant improvement (p= 0.365), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.33 ± 0.36 and 1.9 ± 0.69 respectively which indicated a significant improvement (p= 0.011) in favor of group (A) (MD= 0.57) and % of improvement was 21.42 %.

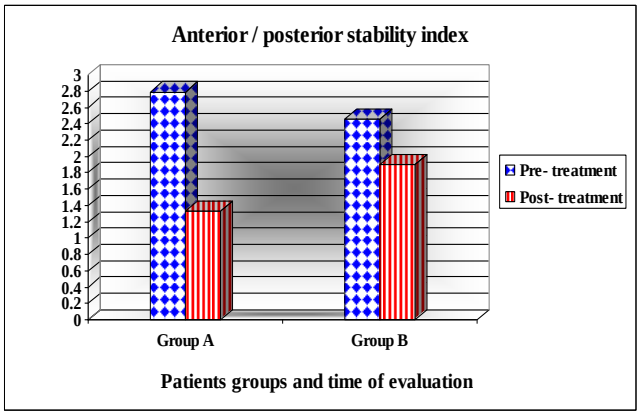

Fig 2: Pre and post treatment mean values of anterior / posterior stability index among the two groups.

3.2 Comparing the mean values of medial / lateral stability index between the two groups:

when comparing the two groups (A and B) before treatment, the mean ± SD values were 2.08 ± 1.01 and 2.29 ± 1.03 respectively which indicated no significant improvement (p=

0.573), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.12 ± 0.41 and 1.67 ± 0.58 respectively which indicated a significant improvement (p= 0.006) in favor of group (A) (MD= 0.55) and % of improvement was 24.55 %.

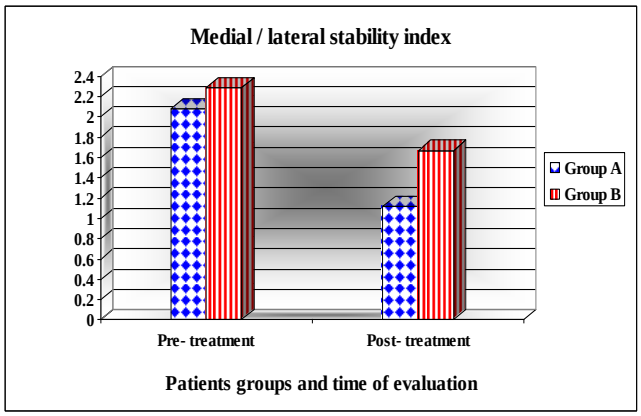

Fig 3: Pre and post treatment mean values of medial / lateral stability index between the two groups.

3.3 Comparing the mean values of overall stability index among the two groups

When comparing the two groups (A and B) before treatment, the mean ± SD values were 3.48 ± 1.05 and 3.07 ± 1.06 respectively which indicated no significant improvement (p= 0.301), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.6 ± 0.31 and 2.11 ± 0.55 respectively which indicated a significant improvement (p= 0.005) in favor of group (A) (MD= 0.51) and % of improvement was 15.93 %.

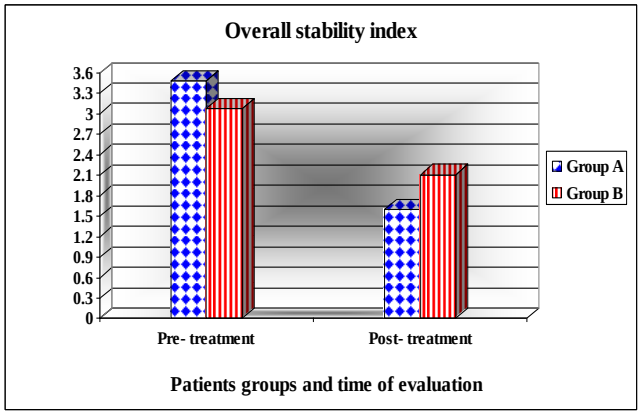

Fig 4: Pre and post treatment mean values of overall stability index between the two groups.

3.4 Comparing the median values of cumberland ankle instability among the two groups:

when comparing the two groups (A and B) before treatment, the median values were 13 and 14 respectively which indicated no significant difference (p= 0.254), while comparing the two groups after four weeks of treatment, the median values were 25 and 21 respectively which indicated a significant difference (p= 0.02) in favor of group (A) (MD= 4) and % of improvement was 4 %.

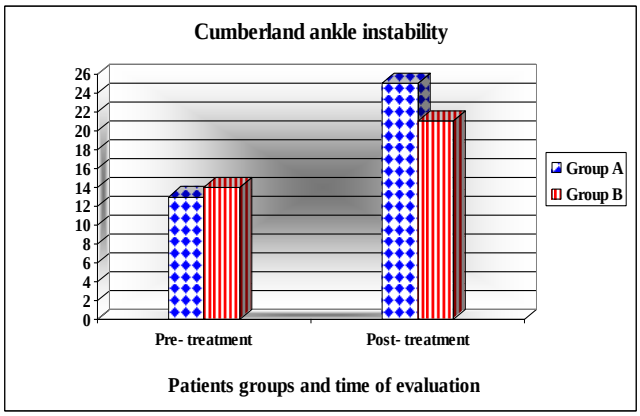

Fig 5: Pre and post treatment median values of cumberland ankle instability between the two groups.

4. Discussion

Lateral ankle sprains (LAS) are one of the most commonly occurring injuries amongst the general population, accounting for upwards of 20% of all joint-related injuries (Gribble *et al*., 2014) [10].

It has been reported that 32-74% of individuals with a previous history of LAS will suffer from residual or chronic symptoms and go on to develop chronic ankle instability (CAI). Chronic ankle instability has been classified as a condition involving ankle pain and swelling with activity, recurring episodes of "giving-way", repetitive ankle sprains and restrictions of or a failure to return to levels of previous activity (Wikstrom and Brown, 2014) [34].

With CAI offering a primarily "symptom-based" presentation due to its complexity and multi-factorial nature, patient questionnaires or surveys have become a widely used tool in identifying the pathology. One such questionnaire is the Cumberland Ankle Instability Tool (CAIT). First published by Hiller in 2006 the CAIT is a 9-item, 30-point questionnaire that is utilized without comparison to the contralateral ankle (Hiller *et al*., 2006) [15].

Among a variety of ankle taping methods, Kinesio taping has positive effects on correcting muscle function, circulation of blood, decreasing pain, repositioning subluxated joints, restoration of the function of the fascia and muscle, and improving proprioception (Lee and Lee, 2015) [27].

The study included 30 subjects; they were divided into two groups:

(Experimental group A): This group Consisted of 15 patients with lateral ankle sprain treated by selected balance training program in form of three sessions per week for four weeks, in addition to taping the ankle joint with adhesive elastic kinesio tape, subjects were taped for a lateral ankle sprain

(Control group B): This group Consisted of 15 patients with lateral ankle sprain treated by selected balance training program in form of three sessions per week for four weeks, the same balance training as group (A) but without the use of kiesio tape to the ankle joint.

The results of present study as follow:

i) For anterior posterior stability

When comparing the two groups (A and B) before treatment,

the mean ± SD values were 2.79 ± 1.05 and 2.46 ± 0.92 respectively which indicated no significant improvement (p= 0.365), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.33 ± 0.36 and 1.9 ± 0.69 respectively which indicated a significant improvement (p= 0.011) in favor of group (A) (MD= 0.57) and % of improvement was 21.42 %.

ii) For Mediolateral stability

When comparing the two groups (A and B) before treatment, the mean ± SD values were 2.08 ± 1.01 and 2.29 ± 1.03 respectively which indicated no significant improvement (p= 0.573), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.12 ± 0.41 and 1.67 ± 0.58 respectively which indicated a significant improvement (p= 0.006) in favor of group (A) (MD= 0.55) and % of improvement was 24.55 %.

iii) For over all stability

when comparing the two groups (A and B) before treatment, the mean ± SD values were 2.08 ± 1.01 and 2.29 ± 1.03 respectively which indicated no significant improvement (p= 0.573), while comparing the two groups after four weeks of treatment, the mean ± SD values were 1.12 ± 0.41 and 1.67 ± 0.58 respectively which indicated a significant improvement (p= 0.006) in favor of group (A) (MD= 0.55) and % of improvement was 24.55 %.

iv) For Cumberland ankle instability

When comparing the two groups (A and B) before treatment, the median values were 13 and 14 respectively which indicated no significant difference (p= 0.254), while comparing the two groups after four weeks of treatment, the median values were 25 and 21 respectively which indicated a significant difference (p= 0.02) in favor of group (A) (MD= 4) and % of improvement was 4 %.

The primary goal of this study was to investigate the effect of KT on proprioception and functional performance on an injured population, which has been lacking in the KT literature to date. Many of the KT articles have investigated a healthy population For example, Halseth *et al*., 2004[11] concluded that KT did not improve joint reposition sense in the ankle, but the use of only healthy subjects was a major limitation in this study. It was viewed as a limitation because healthy subjects might not have had any proprioceptive deficits, subsequently making it very difficult to see any improvements after the KT application. Clinically, a health care provider would not apply KT to an individual who did not have preexisting deficits. We speculated that an "injured" population who has an actual proprioceptive deficit would respond differently than healthy subjects,

One potential advantage of using KT over other forms of taping or bracing is that it can be worn continuously for several days. By wearing the tape continuously, proprioceptive stimulation is occurring constantly, versus traditional taping or bracing that is only used during athletic participation. (Simon *et al*., 2014) [17]

Previous studies have demonstrated that taping is one of the most common means of supporting a chronically unstable ankle and has a positive protective and rehabilitating effect on those with this condition (Wilkerson *et al*., 2002) [35]. It is, however, beneficial to note that there have been very few studies in previous research looking particularly at the efficacy of Kinesio tape, especially in relation to CAI. This highlights the need for further research, as Kinesio tape is now being used increasingly worldwide, particularly by sports players.

The results of present study comes with agreement with Kwiatkowska *et al*., 2007 who stated that the application of Kinesio tape increased the functional capabilities of participants with acute ankle sprain. This could partly explain the differences as the current study used participants with CAI and in an immediate sense, Kinesio tape may allow a more rapid return to painless movement, though ultimately leading to the same degree of recovery (Thelen *et al*., 2008) [32].

In static balance assessments, subjects who had Kinesio Tape applied demonstrated statistically significant better balance than those who wore no tape. However, it was stated that there was no change in performance in either static or dynamic balance function regardless of the taping technique used in studies (Hopper *et al*., 2009) [19].

The present study was, however, consistent with Hendrick, 2012 who found that it was not possible to determine whether or not Kinesio tape had any effect on the ankle. It has also been suggested that subjects with chronic ankle instability perceive greater stability, confidence and reassurance when tape is applied to that ankle even if functionally there appears to be little difference (Delahunt *et al*., 2010) [10].

The present study was agreed with study of Ben Moussa Zouita *et al*., 2013 the objective was to investigate how the proprioceptive exercises effect the postural balance and isokinetic strength in athletes with ankle sprain. 16 participants were recruited in the study and divided into two groups. The experimental group consisted of 8 participants with unilateral ankle sprain symptoms. The control group included another 8 participants with bilateral non-injured ankles. The training program included 24 sessions during 8 weeks, every session lasted between 20 and 30 minutes. Four prescribed exercises were used during the intervention: one exercise without any material, one exercise with a ball only, one exercise with a balance board only and one exercise with a ball and a balance board. As a result, after 8 weeks of proprioceptive rehabilitation a significant improvement in extensor and flexor strength of ankle at a speed of 60-degree/sec was registered.

The effect of present study was conducted with the results of wilkerson, 2002 [35] that the effect of traditional tape provides superior benefits than no tape may regard to deceleration of inversion velocity and facilitation of dynamic neuromuscular protective mechanisms. Furthermore, tape offers a means to address the complex interrelated biomechanical factors that are responsible for subtalar joint injury and rotatory instability of the talocrural joint.

The present study was agreed with study of Sawkins *et al*., 2007 participants reported improved perceptions of stability, confidence, and reassurance with the placebo tape in place while performing functional tests.

Cordova *et al*., 2005 stated that "lace-up style ankle support and traditional adhesive tape application incorporate material anterior and posterior to the talocrural joint axis". This may restrict plantar flexion ROM that could contribute to a diminished vertical jump height. Vertical jump height could become impaired if the external ankle support decreases functional ROM. Subjects in the current study who were taped with athletic tape demonstrated vertical jump heights that were significantly lower than subjects with other conditions, perhaps due to the restriction of plantar flexion as

described above.

First, the presence of impaired proprioception following a lateral ankle sprain, it is biologically possible that KT may increase afferent input and hence improve measures of proprioception (Willems *et al*., 2002) [36]. Second, KT could increase the self-efficacy of the individual with an unstable ankle, potentially resulting in greater confidence, stability and assurance when performing the Star Excursion Balance Test (SEBT). Also, this come in agreement with the study of Pijnappel, 2009 who found that KT favor other types of tapes in improving postural control and attributed this to the stimulation of the cutaneous extroceptors from the foot and ankle. In our study, KT was found to improve postural stability in all directions which may be attributed to its application on patients with ankle sprain.

In addition, Murray and Husk, 2001 showed that KT enhanced proprioception in individuals who had ankle pathology, because it allowed having its effect on injured tissue.

On the other hand, Halseth *et al*. 2004 [11] reported that KT appears to have no effect as their studies performed on healthy ankles.

Fayson *et al*, 2013 have used the SEBT to evaluate the effectiveness of elastic therapeutic tape applied to the ankle for improving balance in healthy uninjured individuals. These studies have consistently found that elastic kinesio tape does not improve balance in this group. There are several potential reasons for these findings, but the results lead us to believe that initial proprioceptive deficits must exist in some sort of pathology for the elastic therapeutic tape to have a detectable impact on these reaching tasks.

The effect of traditional tape provides superior benefits than no tape may regard to deceleration of inversion velocity and facilitation of dynamic neuromuscular protective mechanisms. Furthermore, tape offers a means to address the complex interrelated biomechanical factors that are responsible for subtalar joint injury and rotatory instability of the talocrural joint (Wilkerson, 2002) [35].

Theoretically, KT, when applied specifically to reduce ligament/proprioception deficits has an effect on the cutaneous mechanoreceptors, essentially leading to improved proprioception (Baltaci *et al*., 2012) [2]. Ideally white non-elastic tape, when applied utilizing the closed basket weave procedure will restrict excessive range of motion by acting as an external ligament (Knight and Weimar, 2010) [25].

KT increases blood circulation in the taped area (Kase *et al*., 2003) [22] and that this physiological change may affect the muscle and myofascial functions after the application of the KT. Another theory suggests that the KT stimulates cutaneous mechanoreceptors at the taped area, and this stimulation may affect the ROM (Halseth *et al*., 2004) [11]. Therefore, muscle function could be improved with the KT by regulating muscle tone (Sijmonsma, 2007) [31].

Previous research has shown balance benefits from the tape in patients with multiple sclerosis (Cortesi *et al*., 2011) [5]; however, studies in which the tape is applied to the ankle have yielded limited or no improvements in proprioception (Halseth *et al*., 2004) [11].

The elasticity of Kinesio tape is unique compared to standard white athletic tape and reportedly leads to the enhancement of joint function (Yoshida and Kahanov, 2007) [38] as the tape aids the lymphatic and circulatory systems, releasing abnormal muscle tension, thereby restoring normal function. It does this by lifting the skin, producing a greater gap between skin and muscle, allowing more space for blood and lymphatic flow, leading to increased muscle function (Kinesio, 2011) [24].

Kase and Hashimoto, 1998 stated that Kinesio tape takes effect within 10 minutes of application, however an increase in the time granted for study. Thelen *et al*., 2008 found an early benefit (within one day) in subjects with shoulder injuries to whom Kinesio tape was applied, rather than within minutes. As Kinesio tape is in some cases regarded as primarily for rehabilitation (Hendrick, 2012) [13], particularly in dealing with chronic issues such as CAI, which take longer to heal than an acute ankle sprain, further time for effect could be of benefit.

Matsusaka *et al*., 2001 found improved functional dynamic balance, through assessment of postural sway on an ankle disk in participants with CAI, when a single strip of white tape was applied over the lateral peroneal muscles. Whether it is specifically Kinesio tape which produces an effect or the presence of any supportive tape leads to the improvement remains to be investigated.

5. Conclusion

Finally it was concluded that kinesio taping had improvement on pain, balance and functional performance in patient with lateral ankle sprain.

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