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The effect of adding ankle taping to proprioception training after chronic lateral ankle sprain

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ABSTRACT:

Background: Balance training is an integral part of rehabilitation after ankle sprain. Ankle taping is used to increase ankle stability and proprioception. **Aim**: To compare the effect of applying ankle tapeduringproprioception training and using balance training alone on improving proprioception and ankle joint function after chronic lateral ankle sprain. **Methods**: The study was conducted on thirty athlete patients randomly assigned into two groups. Group (A)received a selected balance-training program three sessions per week for six weeks, with taping the ankle joint with adhesive non-elastic tape during training program.Group (B), received the same balance training program as group (A) but without taping the ankle.Variables includedankle joint function measured by the foot and ankle disability index (FADI)and the balance measured by Biodex balance system (BBS). Assessment was done before and after treatment**Results:** Statistically significant improvement in balance was noted for group A compared with group B in the posttest(P. value = 0.048). Statically no significant difference was found in ankle joint function between both groups in the posttests(P. value = 0.347 in FADI) and (P. value = 0.110 in FADI sport).**Conclusion:** applying ankle tape during proprioceptive training of the ankle is more effective than proprioceptive training alone in improving balance but not function in patients with chronic ankle sprain.

Keywords:Taping, balance training, ankle joint function, chronic lateral ankle sprain.

INTRODUCTION

Lateral ankle sprain is an extremely common athletic injury [23], in all sports injuries, the rate of ankle sprains ranges from 15 to 20%[12], with more than 40% of cases becoming recurrent following the initial incident [7].

Eighty percent of ligamentous sprains are caused by excessive inversion force at or before landing and also by delayed reaction time of the peroneal muscles at the lateral aspect of the ankle [6].Improper positioning may be due to the loss of proprioceptive input from mechanoreceptors [23].

The ankle injury may disrupt joint afferents located in the supporting ligaments. After injury to the nervous and musculotendinous tissue, proprioceptive deficits are likely to occur [23].

Repeated ankle sprain may lead to perceived and observed deficits in neuromuscular control and mechanical stability, known as chronic ankle instability [9]. It is widely believed that the tendency for ankle sprains to reoccur is due to proprioceptive deficits [14, 16].

Ankle taping is one of the most popular methods of supporting a weakened ankle from undergoing a further sprain. In addition, taping can prevent joint hypermobility [23], it is hypothesized that it prevents further sprains by enhancing proprioceptive acuity [1].This is believed to be achieved through the activation of the skin receptors, which offer additional awareness of the foot position and the direction of motion [22].

There is inconclusive evidence to determine the clinical efficacy of the effects of proprioceptive exercise and taping in subjects with chronic ankle injuries [10]. The pairing of balance training and taping may provid therapists with a more effective program of treatment and aid to prevent recurrence of lateral ankle sprain. So this study aims to detect the effect of this pairing on improving balance and ankle joint function after chronic ankle sprain.

The purpose of the study was to compare the effect of using ankle taping in addition to balance training and using balance training alone on improving balance and ankle joint function after chronic ankle inversion sprain.

Materials and methods:

Subjects:

Thirty athlete patients (football, volleyball, handball and basketball players) participated in this study. Their ages ranged from 18-35 years. They were diagnosed clinically as grade II chronic ankle sprain and were referred by an orthopedic surgeon six weeks after injury. Patients were randomly assigned into two experimental groups.

Group (A): Consisted of 15 patients who received a selected balance training program three sessions per week for six weeks, in addition to taping the ankle joint with adhesive non elastic tape in the form of closed basket weave technique during training program.

Group (B): Consisted of 15 patients who received the same balance training program as group (A) but without taping the ankle

Patients were excluded from the study if they had: any pathological condition of lower extremities such as tumors and infections or in the foot as deformities, skin diseases or history of allergy to adhesive tapes, any condition that can affect balance as middle ear problem, or any condition that affect sensory feedback as diabetes mellitus or peripheral neuropathy. Patients diagnosed as recurrent ankle sprain were excluded.

Assessment Instrumentation

1. *Foot/ ankle disability index:*

It consists of thirty-four items questionnaire divided into two subscales: the foot and ankle disability index (FADI) and the foot and ankle disability index sport (FADI sport). The foot FADI contains 4 pain related items and 22 activity related items. The foot and ankle disability index sport contains 8 activity related items. The FADI and the FADI Sport are scored separately[2]**.** The activities are rated as; no difficulty at all (4 points), slight difficulty (3 points), moderate difficulty (2 points), extreme difficulty (1 point), unable to do or N/A (not applicable) (0 points). Pain related to the foot and ankle were rated as; no pain (4 points), mild (3 points), moderate (2 points), severe (1 point), or unbearable (0 points)[19]**.**

2. *Biodex Balance System*

The biodex balance system(BBS) consists of movable balance platform. The degree of surface instability ranges from a completely firm surface, stability level 8, to a very unstable surface, stability level 1[20]**.**

Postural stability can be measured in the anterior-posterior or the medial-lateral directions. Postural stability is expressed in terms of stability index (SI). The SI quantifies the subject's ability to control the tilting of the platform during a test. A high SI is an indicative to a lot of movement during a test and therefore less stability[18].

Assessment procedures

Subjects who met inclusion criteria were interviewed, the purpose and procedure of the study were fully explained. Subjects who agreed to join the study signed an informed consent form. Research proposal was approved from the ethical committee, Faculty of physical Therapy, Cairo University.

1. *Assessment of the functional activities of the ankle joint:*

By the foot/ ankle disability index (FADI). Patients were instructed to answer each question with one response that most closely described his condition within the past week. The sum of the scores was calculated. The FADI has a total point value of 104 points, and the FADI sport has a total point value of 32 points, representing no dysfunction**.**The more the total score the better the patient's function.

2. *Balance assessment using Biodex Balance System (BBS*):

The patient's data and test protocol were entered to the system. Patients were assessed for single-limb (the affected limb) while the other limb was 70 degree knee flexion and both hands beside the body. The stability of the support platform was decreased progressively from level 6 to level 1 in40 seconds-times with eyes open. Patients were asked to try to maintain their center of gravities (represented by an(X) marked directly in front of them in the center of the screen in the center of the circle and the platform in a level position. They were given a 1-minute rest between testing conditions.

All assessment procedures were done before the treatment program and 6 weeks after (at the end of the treatment program).

Treatment instrumentation

1. Ankle tape:

The tape used in this study was Mueller® tape; non-elastic white zinc oxide tape 3.8 cm (1.5 inch) (mueller sports medicine, inc. Wisconsin, US), the tape was slightly porous to permit some lateral glide or stretch (shearing) across the bias of the tape.

For the under-wrap 3M micropore® tape (3M St. Paul, Minnesota)was used.

Treatmentprocedures:

- *Group A*

All patients in this group received 18 sessions of balance training (three sessions per week for 6 weeks) progressing from most simple to the most complex sessions with application of adhesive non-elastic tape on the ankle joint in the form of closed basket weaves technique. Exercises included standing on a fixed surface, tilt board, or wobble board and performing functional hop series. Subjects stood on the affected limb with the contralateral knee flexed to approximately 75˚. Exercises were performed with eyes open and with eyes closed and the patient in each exercise tried to balance himself within his base of support.Time of each exercise was increased progressively while time of rest between exercises was decrease

Ankle taping:

The closed basket weaves technique of taping for ankle inversion sprainwas applied to support lateral ligaments without limiting motion unnecessarily. Patient's leg and foot had to be clean, dry and shaved.

Patients sat on couch or bench with foot and ankle over edge. Foot was dorsiflexed and everted.A layer of non-adhesive non-irritating tape, called the underwrap, wasapplied (Micropore® type 7.5cm) in a figure-of-eight shape around the ankle joint, Two circular turns(anchors) were applied to the leg about 10 cm above the malleoi, and to the midfoot. These anchors overlapped the underwrap by 2 cm and adhered directly to the skin. The vertical stirrup was applied first, started on the medial side of the anchor and continued down posterior to the medial malleolus, under the heel and up the lateral side (with tension) and attached to the anchor and did not mould to leg. Then applied a horizontal strip, started on the lateral side of the anchor, continued around the heel and attached to the medial side of the foot anchor. Vertical and horizontal strips were continued alternately until the ankle was covered. Each strip overlaped the preceding one by one-third. Filled with locking 1/2 fill strips between anchors.

- *Group B*

All patients in this group received 18 sessions of the same balance training program as in group (A) (3 sessions per week for 6 weeks) but without application of the tape.

Statistical analysis:

Statistical analysis was conducted using SPSS software version 16. Paired t-test was used to compare patients within the same group. Unpaired t-test was used to compare patients of different groups. Differences were considered significant at $p \geq 0.05$

RESULTS:

Balance assessment (stability index)

Within groups:

In group A, there wasstatistically significant difference in the value of the stability index (P=0.014) as shown in table (1).

In group B, there wasno statistically significant difference between the pre and post tests in the value of the stability index (P=0.084) as shown in table (1).

Between groups:

By comparing the two studied groups, There was no statistically significant difference in the mean stability index value in the pre-test between both groups (P. value = 0.325). There was statistically significant difference in the mean stability index value in the post-test between both groups (P. value = 0.048) as shown in table (2).

Table (1): Mean, standard deviation and p value of Stability index in both groups before and after treatment.

	Pre test	Post test	P value
Group A	5.88±1.66	4.16±1.30	0.014*
Group B	5.38±0.98	4.88±0.81	0.084
P value	0.325	0.048*	

*significant difference

The foot ankle disability index (FADI):

Within groups:

In group A, the results revealed statistically significant difference between the pre test and post test in the value of FADI score (P=0.049) as shown in table (2).

In group B, there was also astatistically significant difference in the value of FADI score between the pre test and the post test (P=0.048) as shown in table (2).

Between groups:

By comparing the two studied groups, It was found that there was no statistical significant difference in the mean FADI score value for the pre-test between both groups (P. value = 0.317). There was also no statistical significant difference in the mean FADI score value for the post-test between both groups (P. value = 0.347) as shown in table (2).

Table (2): Mean, standard deviation and P values of FADI score in both groups before and after treatment.

	Pre-test	Post-test	P value
Group A	71.92±9.88	88.13±5.91	0.049*
Group B	76.28±13.28	85.25±10.05	0.048*
P value	0.317	0.347	

*significant difference

The foot ankle disability index sport (FADI sport):

Within groups:

In group A, results showed statistically significant difference in the value of FADI sport score (P=0.001) as shown in table (3).

In group B, there was nostatistically significant difference in the value of FADI sport score (P=0.057) as shown in table (3).

Between groups:

By comparing the two studied groups, there was no statistically significant difference in the mean FADI sport score value for the pre-test between both groups (P. value = 0.240). There was no statistical significant difference in the mean FADI sport score value for the post-test between both groups (P. value = 0.110) as shown in table (3).

Table (3): mean, standard deviation and p value of FADI sport score in both groups before and after treatment.

FADI sport score	Pre-test	Post-test	p. value
Group A	63.77±20.91	92.50±7.16	0.001
Group B	72.10±16.69	87.05±10.38	0.057
P value	0.240	0.110	

*significant difference

DISCUSSION

The results of this study showed that there is a significant difference between using non elastic tape in addition to balance training and using balance training alone on improving balance, the combination between taping and balance training showed more improvement in balance after ankle inversion sprain, and also the study stated that there is no significant difference between both on improving ankle joint function after ankle inversion sprain.

The positive effect of taping on balance comes in agreement with those by Matsusaka et al.Who found that the application of 1-cm wide non-elastic adhesive tape to the skin around the lateral malleolus during balance training resulted in earlier improvement in postural sway in comparison with balance training without taping[15].Basket weave technique showed superior effect on balance to other taping echniquesin participants with chronic ankle instability (CAI)[3].

The positive effect of taping on balance is thought to be due to the ability of the tape to enhance proprioceptive acuity[1]. This is believed to be achieved through the activation of the skin proprioceptive receptors, which offers additional awareness of the foot position and the direction of motion[22].

Robbins et al. found that taping improved proprioception in uninjured ankles or university students[17].Spanos et al. investigated the effects of closed basket weave taping on the proprioception of the ankle among injured athletes, who suffered from unilateral grade I or grade II ankle inversion sprain, and found that taping improved the ankle position awareness of the subjects and thus, their proprioceptive ankle capability when tested in non weight bearing position[21].

On the other hand, the results of this study contradicts with those by Kaminski and Gerlach and Jerosch et al.Kaminski and Gerlach (2001)found no improvement in the angle-reproduction test with an isokinetic dynamometer in uninjured subjects with the application of the basket weave technique over a taping underwrap base[13]. Similarly, Jerosch et al. (1996)found that taping did not improve the results of reproduction test in injured and uninjured subjects[11].

Conclusion:

Adding ankle taping (in the closed basket weave technique)to balance training is more effective on improving balance than applying balance training alone in patients with grade II lateral ankle sprain.

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الملخص العربي

تأثير اللاصق الطبي على الاتزان والأداء الوظيفي لمفصل الكاحل بعد التمزق المزمن للرباط الخارجي

الهدف من الدراسة: هو مقارنة تأثير اللاصق الطبي مع تمارين الاتزان وتأثير تمارين الاتزان منفردة على الاتزان والأداء الوظيفي لمفصل الكاحل بعد التمزق المزمن للرباط الخارجي**تصميم البحث**: شارك في هذه الدراسة ثلاثون مريضا تتراوح أعمارهم بين الثامنة عشرة وبين الخامسة والثلاثون سنوو تم تقسيم المرضي عشوائيا على مجموعتين: المجموعة الأولى تحتوى على خمسة عشر مريضا يقومون بتنفيذ برنامج لتمارين الاتزان مصاحبا بوضع اللاصق الطبي غير المرن على الكاحل أثناء تنفيذ البرنامج وذلك من خلال ثلاث جلسات أسبوعية ولمدة ستة أسابيع متصلة. المجموعة الثانيةتحتوي على خمسة عشر مريضا أيضا يقومون بتنفيذ نفس برنامج الإتزان المتبع في المجموعة الأولى ولكن بدون تطبيق اللاصق الطبي على الكاحل.تم تقييم الأداء الوظيفي لمفصل الكاحل بإستخدام "مؤشر العجز للقدم والكاحل"، كما تم تقييم الإتزان بإستخدام جهاز "بايوديكس لنظم الإتزان" وذلك فى المجموعتين قبل وبعد برنامج العلاج الطبيعي**النتائج:** لقد أظهرت النتائج احصائيا تحسنا كبيرا وفرقا ذو دلالة إحصائية فى الإتزان فى المجموعة الأولى مقارنة بالمجموعةالثانية، كما أظهرت أنه لا يوجد فرق ذو دلالة إحصائية بين المجموعتين فى تحسن الأداء الوظيفي لمفصل الكاحل. **الخلاصة:** لقد أوضحتالدراسةأن إستخدام اللاصق الطبي غير المرن مع تمارين الإتزان يساعد على تحسن الإتزان بصوره أكبر من إستخدام تمارين الإتزان منفردة ولا يساعد بشكل ملحوظ على تحسن الأداء الوظيفي لمفصل الكاحل

الكلمات الدالة: اللاصق الطبي، تمارين الإتزان، الأداء الوظيفي للكاحل، التمزق المزمن للرباط الخارجي لمفصل الكاحل.