# Effectiveness of a closed-basket weave ankle tape in reducing ankle range of motion and improving dynamic balance: a pilot study

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## Abstract

**Context:** Ankle injuries are one of the most common injuries amongst the active adult population. Previous research has shown that ankle taping is an effective intervention for treating ankle sprains. However, no authors have compared this intervention to a sham intervention to rule out the possibility that the results are due to increased kinesthetic awareness or increased sensory response due to taping.

**Objective:** To evaluate the effectiveness of a closed-basket weave ankle taping in limiting range of motion (ROM) and improving dynamic balance during a performance assessment.

**Design**: Randomized Controlled trial

**Setting**: Exercise physiology lab

**Patients or Other Participants**: 10, 18-35-year-old active adults; 5 males and 5 females. 6 received the closed-basketweave taping intervention and 4 received the sham ankle tape

**Intervention(s):** Each participant will wear either the closed-basket weave tape or the sham tape. ROM and balance will be assessed several times throughout the study.

**Methods and Measures**: Ankle ROM will be measured for inversion, eversion, plantar flexion, and dorsiflexion. Balance will be measured using the Y-Balance test. All measurements will be taken for: baseline, post-intervention, and at 5-minute intervals during the performance assessment.

## BACKGROUND AND CONTEXT

Ankle injuries are one of the most common injuries second to the knee. Of all the ankle injuries, ankle sprains occur the most.[1] Waterman et al.[2] recorded data for four years and found that ankle sprains have an incidence rate of 2.5 per 1000 persons. Many of these ankle sprains were among the everyday, active adult population, rather than sports related.[3] The ankle is comprised of two joints, with range of motion (ROM) in the transverse (horizontal) and sagittal (frontal) planes. The first is the talocrural joint. This is the connection of the talus with the medial and lateral malleoli. This joint allows the foot to move in the sagittal plane through plantar flexion and dorsiflexion. The second is the subtalar joint. This is the connection of the talus with the calcaneus. This joint allows the foot to move in the transverse plane through inversion and eversion.

The most common mechanism for an ankle sprain is when the foot is inverted while in a plantar flexed position.[4] This position poses a threat to the anterior talofibular (ATF) ligament and the calcaneofibular (CF) ligament. The closed-basket weave ankle tape was designed to limit ankle ROM and reduce the risk of that mechanism. A study done by Tregouet et al.[5] revealed that non-elastic ankle taping reduced ROM more than other variations of taping.

Dynamic balance is important for athletic performance. Poor dynamic balance can indicate chronic ankle instability and put an active individual at risk for lower extremity injuries[6]. There are new training plans and interventions to help improve dynamic balance and older studies have also been done on the effectiveness of taping in improving dynamic balance due to the increased proprioception.[7] The study showed that the stimulation of the cutaneous mechanoreceptors improved ankle joint perceptions. Other studies have been done to examine the effect of other prophylactic ankle supports on dynamic balance[8,9]. According to a study done

by Plisky et al.[10] the Y-Balance is a reliable tool for assessing dynamic balance and risk of lower extremity injury.

## METHODS

A total of ten subjects were tested. Six received the intervention, and the other received the sham. There were five males and 5 females that participated in the study. The participants were 21.33±.577 years old and weighed 82.47±18.73kg. The average height was 73.57±25.75cm and the average leg length was 93.67±7.94. The study was divided into four parts; 1) Application of inclusion and exclusion criteria, 2) baseline measurements, 3) Pre-activity measurements, 4) Performance assessment and post-activity measurements. During part one of the study participants were assessed for inclusion and exclusion criteria. In order to participate in the study, participants must be above 18 years old, able to engage in 30 minutes of moderate activity, and clear of any lower extremity injuries for at least 6 months. If the participant did not meet the eligibility requirements and did not present any of the exclusion criteria, they contributed their dominant foot to parts two through four of the study. Each of the four parts occurred immediately following the previous. The whole study took about 90 minutes to complete.

After the consent form is signed and medical questionnaire is complete, participants were measured for ankle range of motion (ROM) in all four directions: dorsiflexion, plantar flexion, eversion, and inversion. All measurements will be taken with a handheld goniometer. Each participant was measured in a supine position, with the knee bent ankle unsupported off the edge of the table to reduce influence of the gastrocnemius. The patient was also measured barefoot and remained barefoot for the entirety of the study. When measuring ankle dorsiflexion and plantar flexion the lateral malleolus was palpated. The fulcrum of the goniometer was placed in

the center of the lateral malleolus. The stationary arm was placed along the fibula while the movement arm is parallel to the fifth metatarsal. The patient was asked to move through ankle dorsiflexion and plantar flexion while data is being collected. To measure ankle inversion and eversion, the anterior portion of the talus was palpated to locate the talocrural joint where the fulcrum was placed. The stationary arm was placed along the anterior portion of the tibia while the movement arm is placed over the second metatarsal. Once ROM measurements have been collected the participant was assessed for dynamic balance. The Y-Balance test was used to assess the dynamic balance. The subject performed a single leg stance and placed their hands-on hips. Once in position they reached the non-weight bearing leg in three directions: anterior, posteromedial, and posterolateral. The test was repeated three times in each direction and the furthest distance was recorded.

Once baseline measurements were collected, the subject chose an envelope containing their intervention (closed-basket weave ankle tape or sham ankle tape). If the subject is to receive the sham, an elastic tape will be applied that does not restrict ROM. All intervention applications were done by the same person to ensure consistency in application. Prior to application of the tape, an adhesive spray will be used for maximum adhesive application. Immediately after the tape is applied, the same ROM and balance measurements from part 1 was re-measured.

Once all pre-test data was collected, the participant performed a performance test on the treadmill with moderate activity. Participants remained barefoot with the intervention on. The incline on the treadmill was at 0% and remained at 0% for the duration of the performance test. Measurements of ROM and balance were assessed at 5-minute intervals for 30 minutes. The post-test measurements were taken immediately after the completion of the 30 minutes.

# RESULTS

Repeated measures analyses of variance (RM-ANOVAs) was used to interpret the statistical analysis. During analysis of the data it was found that there was a significant difference in plantar flexion pre-intervention application (M=27.65±6.09) and post-intervention application (M=15.13±5.31); p=<.001 of the closed-basketweave ankle tape. There was a significant difference noticed with inversion pre-intervention application (M=33.32±7.43) and post-intervention application (M=15.02±5.84); p=.014 of the closed-basketweave. Significant differences were also noted from baseline to post-intervention application in dorsiflexion, inversion, and eversion. When comparing the overall t-test that shows the significance between the sham and the closed-basketweave intervention, there was no significant difference in pre-intervention application of plantarflexion t(8)=-.773; $p$=.462, but significant difference was noted post-intervention application t(8)= -3.708; $p$=.006. However, there was no significance when after the 10-minute interval t(8)= -1.224; $p$= .249. This was also noticed with inversion in which there was no significant difference pre-application t(8)=-1.77; $p$=.864, significant different post-application t(8)=-3.16; $p$=.013, and the significance diminished after the 10-minute interval t(8)=-1.39; $p$=2.00.. During the pre-intervention application the dorsiflexion t(8)=-1.33; $p$=.219 and eversion t(8)=-1.77; $p$=.296 showed no significant difference. Post-intervention, application both dorsiflexion t(8)=-2.749; $p$=.025 and eversion t(8)= -2.82; $p$=.023 showed significant difference. Dorsiflexion and eversion were slightly different, in that the significant difference between the sham and closed-basketweave diminished after the 5-minute interval.

There were no significant differences with anterior, posterolateral, and posteromedial y-balance scores with both the sham intervention and the closed-basketweave intervention during

the post-application measurements. When using the overall t-test to compare, pre-intervention anterior t(8)=.981; $p$=.355 and posterolateral t(8)=2.85; $p$=.022 we insignificant between the sham and closed-basketweave. However, the baseline t-test of posteromedial t(8)=3.92; $p$=.004 unexplainably showed significance between the two interventions. Post-application, anterior t(8)=.653; $p$=.532, posteromedial t(8)=1.165; $p$=.278, and posterolateral t(8)=1.55; $p$=.160, showed no significant difference between the two interventions.

## DISCUSSION

The purpose of this study is to determine the effectiveness of the non-elastic, closed-basket weave ankle tape in reducing ankle range of motion and improving dynamic balance in the active adult population. There are several long-term conditions that can result from ankle injuries including chronic ankle instability and posttraumatic osteoarthritis[3]. Finding an intervention that can reduce the risk of ankle sprains is crucial. Ankle taping is commonly used in the clinical setting to help those who are at risk for ankle injuries. It is important that any interventions used, are able to restrict the ranges of motion, such as plantar flexion and inversion, which commonly cause injury to the ankle ligaments. Determining effectiveness of this intervention can improve clinical decisions when working with this population.

Our findings showed that there was a significant change in plantar flexion, dorsiflexion, inversion, and eversion pre and post intervention application. There were no significant differences in plantarflexion and inversion after the 10-minute interval, and dorsiflexion and eversion after the 5-minute interval. The intervention proved to be effective in reducing all 4 ranges of motion during the performance assessment. The results are similar to those in other studies that have looked at ROM using white tape[11,12,13]. One study in particular was done in

1995 by Paris et al.[11] He compared the reduction in ankle range of motion with cloth tape and prophylactic braces during a performance assessment over a period of time during. The results showed a significant increase in plantar flexion and inversion post intervention application. However, when comparing results, that study showed significant increases 15-minutes into the performance assessment, whereas this study showed significant increases until 10-minutes into the performance assessment. Congruent with the other studies, the rest of the ranges of motion showed significant changes from pre to post application. The sham ankle tape did not affect range of motion in anyway and highlighted the significant differences from the closed-basketweave intervention when compared using the t-test. There were significant differences between the immediately after the application of the actual intervention when compared to the post-application of the sham in all four ranges of motion in the ankle.

There were slight changes in dynamic balance, however, none were significant. There was a research study done by Hardy et al.[14] that evaluated the effect of prophylactic ankle braces during the star excursion balance test. These findings showed that the ankle brace had no effect on the reach distance, which is similar to what is seen with the cloth tape. There have been many programs designed to improve dynamic balance outside the use of any interventions. Dynamic balance is important for anyone that participates in sports, and when it is deficient, there is a greater risk for injury to the lower extremity.

There were a couple limitations with this study. The biggest being the low sample size due to lack participants for this time period.

## CONCLUSIONS

During this preliminary study, the closed-basketweave ankle taping technique proved to be an effective intervention for reducing plantar flexion, dorsiflexion, inversion, and eversion

during the performance assessment. This reduction in range of motion, especially plantarflexion and inversion, could indicated that this intervention can help in the reduction of ankle sprains din the active adult population. No other variables were significantly affected. This was a pilot study, and the data will be used to adjust the variables of this study to achieve new results. This will allow for more participants, so it increases the chances of seeing any non-significance or significant changes pre and post intervention application. In addition, we hope to see more significant changes in range of motion throughout the performance assessment and with the balance variable. Using the data collected, this study will be advanced to determine the effect of this intervention on different variables that affect athletic performance.

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