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after an ankle sprain, increased laxity may cause some of the subjective functional deficits reported in those with CAI. Therefore it is necessary to prevent increases in laxity post ankle sprain, to hopefully improve patients subjective level of function.

The Effects Of Functional Ankle Instability And Induced Fatigue On Ankle Stiffness

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Context: Fatigue is defined as diminished ability to produce force and may be important when attempting to understand the factors that lead to functional ankle instability. Due to potential detrimental effects muscle fatigue may have on joint stiffness, it can be hypothesized that an alteration in ankle stiffness due to fatigue may lead to increased predisposition to lateral ankle sprain during athletic activity. **Objective:** To investigate effects of fatigue and functional ankle instability on ankle stiffness. **Design:** Repeated measures pre-post fatigue measurement of ankle stiffness in stable and functionally unstable ankles. **Setting:** College laboratory setting. **Patients or Other Participants:** Forty physically active subjects with no current lower extremity injury (14 men and 26 women, age = 21.7 ± 2.5 yrs, weight = 74.7 ± 20.9 kg, height = 173.3 ± 11.0 cm) were assigned to stable and functionally unstable ankle groups based on their scores on the Ankle Instability Instrument. **Interventions:** Peroneus longus fatigue was achieved via a 20% MVIC sustained hold isometric eversion fatigue protocol. Fatigue was defined as the inability to produce 10% MVIC (50% of target) for 10 consecutive seconds. **Main Outcome Measure(s):** Ankle stiffness (Nm/rad) was measured on a custom built inversion-eversion swaying cradle device. Peroneus longus EMG pre-activation amplitude (mean EMG amplitude 250ms prior to perturbation) (% MVIC) and EMG amplitude (mean EMG amplitude 500ms following perturbation)(% MVIC) were calculated. Three 2 (stable, functionally unstable) x 2 (pre-fatigue, post-fatigue) mixed model repeated measures ANOVAs were utilized for statistical analysis. **Results:** For ankle stiffness there were no significant differences between fatigue conditions (pre-fatigue = 38.03 ± 9.81 Nm/rad, post-fatigue = 38.14 ± 12.02 Nm/rad, $P = 0.51$) or stability (stable = 35.81± 8.06 Nm/rad, unstable = 40.37 ± 12.85 Nm/rad, $P = 0.29$), and there was no significant fatigue x stability interaction ($P = 0.17$). There was a significant difference between fatigue conditions for EMG amplitude ($P = .04$) with pre-fatigue EMG (15.97 ± 16.13 %MVIC) greater than post-fatigue EMG (11.72 ± 15.45 %MVIC). There was also a significant difference between fatigue conditions for EMG pre-activation ($P = .01$) with pre-fatigue EMG (28.43 ± 25.58 %MVIC) greater than post-fatigue EMG (20.92 ± 20.63 %MVIC). **Conclusions:** Following a sustained hold isometric fatigue protocol, peroneus longus fatigue decreased EMG pre-activation and EMG amplitude but did not appear to have a clear effect on ankle stiffness. These findings may begin to lay the foundation for an understanding of compensatory mechanisms utilized by athletes with functionally unstable ankles to prevent re-injury. They may also shed light on the physiological changes that occur following fatigue that pre-dispose athletes to initial or re-injury.

A Talar Positional Fault Is Present In Individuals With Chronic Ankle Instability

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Context: The underlying mechanism of chronic ankle instability (CAI) remains unknown. However, the presence of tibiotalar and/or distal tibiofibular positional faults has been hypothesized as causal mechanisms of CAI. While distal tibiofibular positional faults have been reported, no investigation has determined if a talar positional fault is present in individuals with CAI. **Objective:** The objectives of this study were to: 1) determine if anterior talar displacement differs among uninjured controls and individuals with CAI and 2) determine cutoff scores for discriminating between controls and CAI. **Design:** Case control study. **Setting:** Controlled laboratory setting. **Participants:** Forty-eight subjects, 24 controls (21.8± 2.6yrs; 170±10cm; 73±16kg) and 24 CAI subjects (21.7±2.8yrs; 175±13cm; 71±13kg) participated. CAI patients had a previous moderate ankle sprain that required acute care, at least one recurrent sprain within six months of testing and scored <20 on the ankle joint functional assessment tool. **Interventions:** Each subject had a single lateral radiograph taken of each ankle. Subjects were positioned side lying while steps were taken to maintain a neutral position of the hip, knee and ankle to ensure a perfect lateral image. The average of three blinded measurements, taken on separate days, was recorded and used for further analysis. An independent sample T-test determined differences between the CAI involved ankle and the matched ankle of the control group. Separate paired sample T-tests determined if side-to-side differences were present between the ankles of the control and CAI groups. A receiver operating characteristic (ROC) curve determined a cutoff score for discriminating between controls and CAI. **Main Outcome Measures:** The sagittal plane talar position, relative to the tibia, was then calculated as the distance between the most anterior margin of the inferior tibia and the most anterior margin of the talar dome in millimeters. This measurement technique has good intra- (0.88) and inter-tester reliability (0.82). **Results:** The talus of subjects with CAI (3.69±1.37mm) was significantly more anterior than the talus of controls (2.65±1.24mm) (p=0.02). The involved CAI limb (3.69±1.37mm) was also significantly more anterior than the uninvolved CAI limb (2.98±1.61mm) (p=0.03). Side-to-side differences were not seen in the control group (matched involved: 2.65±1.24mm, matched uninvolved: 2.79±.27mm) (p=0.11). A cutoff score of 3.1mm had the greatest sensitivity (0.63) and least false positive score (1-specificity=0.41) for discriminating between controls and CAI (asymptotic significance =0.04) **Conclusions:** A talar positional fault is present in the involved limb of individuals with CAI relative to their uninvolved limb and compared to the matched limb of an uninjured control group. The presence of a talar positional fault suggests that anterior-to-posterior mobilizations of the talus relative to the tibia should be performed on individuals with CAI to correct this positional fault.

Lower Extremity Joint Kinematics In Individuals With Chronic Ankle Instability During A Lateral Single Leg Jump Landing

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Context: Chronic ankle instability commonly develops following lateral ankle sprain. Altered lower extremity kinematics may provide rationale for mechanisms of repeated injury and instability in this population. **Objective**: To determine if individuals with mechanical (MAI) or functional (FAI) ankle instability demonstrate altered kinematics of the ankle, knee, hip and trunk compared to a control group during a lateral single leg jump landing. We hypothesized individuals with MAI and FAI would demonstrate greater joint displacement than controls. **Design**: Cross-sectional. **Setting**: Biomechanics Laboratory. **Patients or Other Participants**: Sixty-eight volunteer recreational athletes divided into 3 groups. MAI: 8 males, 13 females, age 19.9±1.0 years, height 172.5±6.7cm, mass 68.7±8.4 kg; FAI: 11 males, 12 females, age

20.3±1.6 years, height 173.4±9.4 cm, mass 70.7±11.9 kg; controls: 12 males, 12 females, age 20.0±1.2 years, height 171.1±7.1 cm, mass 65.4±9.8 kg. MAI and FAI groups reported e”2 episodes of ankle instability in the last 12 months. MAI participants had clinically lax lateral ankle ligaments while FAI and control participants did not. **Interventions**: Maximum vertical jump in a lateral direction was measured. Reflective markers were attached to the body using a modified Helen-Hayes marker set. Participants were positioned 70cm lateral to a force platform and asked to perform a jump to 50% of their maximum height. Participants landed on the involved leg and balanced for 8s. Kinematics and kinetics were collected using a 7-camera system (240Hz) synchronized with a force platform (1200Hz). One-way ANOVAs tested for group differences utilizing Tukey post-hoc testing at α=0.05. **Main Outcome Measures**: Ankle, knee, hip, and trunk displacement values in 3 planes were calculated in the 1s after foot contact, identified by vertical ground reaction force. Variables were averaged over 10 trials. Participants also completed the Cumberland Ankle Instability Tool (CAIT). **Results**: Groups were not different in age, height, weight, or jump height (P>0.21). The MAI (18.0±3.2) and FAI (19.7±3.4) groups reported significantly lower ankle joint function (P<0.001) than the controls (28.5±1.5) on the CAIT. The FAI group (15.5°±4.0) demonstrated significantly greater ankle frontal plane displacement than the MAI group (12.7°±2.3°) (P=0.02). The MAI group (17.4°±5.1°) demonstrated significantly less ankle transverse plane displacement (21.1±4.0) (P=0.03) than controls and significantly less hip frontal plane displacement (20.7°±2.4°) than controls (23.3°±3.7) (P=0.03) during landing. No other group differences were noted. **Conclusions**: The MAI group appears to limit ankle and hip joint displacement during lateral jump landings compared to controls, while the FAI group did not display similar patterns. Centrally mediated kinematic changes have been proposed as a contributing factor for ankle instability, and decreased joint displacements may indicate lack of flexible landing strategies in the MAI group. The ability to teach and adapt landing strategies may be an important component in ankle sprain rehabilitation.

Optimal Intensity Stochastic Resonance Stimulation Improves Single Leg Balance In Stable And Unstable Ankles.

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Context: Single leg balance is used for rehabilitation to improve sensorimotor impairments. Therapeutic interventions that enhance balance may have implications for facilitating rehabilitation of functional ankle instability (FAI). Stochastic resonance stimulation (SRS) has improved single leg balance, but maximizing these balance improvements with a customized optimal intensity has not been examined. **Objective:** Our objective was to determine single leg balance improvements associated with SRS administered at a customized optimal intensity for subjects with and without FAI. **Design:** A two-group (FAI, no FAI), two-treatment (SRS_{on} SRS_{off}) cross-over design. **Setting:** Research laboratory. **Patients or Other Participants:** Ten uninjured subjects without FAI (168.4±5.7 cm, 60.6±6.1 kg, 21.6±1.2 yrs) and 10 subjects with FAI (172.5±7.6 cm, 67.3±10.1 kg, 22.5±3.1 yrs) who reported "giving-way" sensations at their ankles and recurrent ankle sprains with physical activity (sprains=3.0±1.8, "give-ways"/week=0.54±0.62). **Interventions:** Vibrating tactors were placed over peroneal, anterior tibialis, gastrocnemius, and posterior tibialis muscles on the leg with FAI or a matched test leg of uninjured subjects. A random noise signal generated in a stimulation unit caused the tactors to vibrate (SRS). A customized optimal intensity was determined by finding the intensity that produced the slowest center-of-pressure velocity during double leg balance. Subjects then performed a single leg balance test without vision or shoes under SRS_{on} and SRS_{off} conditions. The SRS_{on} condition was administered at the customized optimal intensity. Subjects performed 3 trials for each condition and were asked to remain as motionless as possible for 20 s. A two-factor mixed-model repeated measures ANOVA with 1 within treatment factor (SRS_{on}, SRS_{off}) and 1 between group factor (FAI, no FAI) was used for analysis for each outcome measure (α=.05). **Main Outcome Measures:** Anterior/posterior (A/P) and medial/lateral (M/L) balance were quantified with center-of-pressure velocity (COPV), center-of-pressure excursion (COPE), and 95th percentile center-of-pressure area ellipse (COPA-95). Lower values indicated improved balance. **Results:** Significant main effects for treatment were found, indicating that SRS_{on} improved balance over the SRS_{off} condition (1. A/P COPV: $F_{(1,18)}$=8.54, P=0.009, SRS_{on}=0.63±0.14 cm/s, SRS_{off}=0.69±0.17 cm/s; 2. M/L COPV: $F_{(1,18)}$=6.12, P=0.024, SRS_{on}=0.36±0.14 cm/s, SRS_{off}=0.40±0.17 cm/s; 3. M/L COPE: $F_{(1,18)}$=8.90, P=0.008, SRS_{on}=0.15±0.05 cm, SRS_{off}=0.17±0.05 cm; 4. COPA-95: $F_{(1,18)}$=9.61, P=0.006, SRS_{on}=1.15±0.49 cm^2, SRS_{off}=1.48±0.75 cm^2). No significant main effect was found for A/P COPE ($F_{(1,18)}$=3.66, P=0.072, SRS_{on}=0.28±0.06 cm, SRS_{off}=0.31±0.12 cm). No significant main effects for group (P>0.05) or treatment by group interactions (P>0.05) were found. **Discussion:** SRS administered at a customized optimal intensity improved balance between 9-22% over our control condition. SRS reduced M/L COPE, COPA-95, A/P COPV, and M/L COPV. Clinicians may consider administering SRS at a customized optimal intensity to facilitate single leg balance improvements during rehabilitation.

Startle Response Of The Ankle Musculature In Reaction To Repeated Inversion Perturbations

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Context: When the ankle is unexpectedly forced into inversion, the activity of the primary invertor of the ankle may be negating the protective mechanism provided by the primary evertor through a "startle" response, which would cause co-contraction. **Objective:** To determine if the startle response is present during repeated simulated ankle sprain exposures and if a previous ankle sprain affects this response. **Design:** A 3 x 3 repeated measures study. **Setting:** The study was performed in a controlled laboratory setting. **Participants:** Thirty seven healthy volunteers (age=21.54±1.28 years, mass=74.24±17.03 kg, height=1.75±0.091 m), which included 13 with no previous ankle sprain, 14 with a previous lateral ankle sprain, and 10 with a previous high ankle sprain. **Interventions:** The independent variables were ankle injury history, with three levels (no ankle sprain, previous lateral, and previous high ankle sprain) and startle event, with three levels (startle event 1, 2, and 3). The first trial was treated as a separate startle event, since it was the first time the participants were exposed to the inversion perturbation. Trials 2-5 and trials 6-10 were averaged to create the second and third startle events. Statistical analysis included a 3 x 3 ANOVA with repeated measures on startle event to analyze the difference in muscle activity between the injury histories and startle events. Muscle activity was recorded with a multichannel electromyography (EMG) amplifier/processor unit (MyoClinical, Noraxon USA INC; Scottsdale, AZ) using bipolar Ag/AgCl disc surface electrodes placed over the muscle belly of the peroneus longus and tibialis anterior. An outersole with fulcrum was placed on the bottom of the participants' shoe that forced them into 25° of inversion upon landing from a 27 cm single leg drop landing. Ten trials were performed, using the dominant ankle