The Relationship between Ankle Joint Laxity and Physical Activity Levels

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ABSTRACT

Context: Ankle sprains remain one of the most common musculoskeletal pathologies. **Objective:** To determine if there is a relationship between ankle joint laxity and physical activity levels in those with chronic ankle instability (CAI). **Design:** Case Control Study. **Setting:** Controlled, research laboratory. **Participants:** Fifteen subjects with unilateral CAI (6 males and 9 females, age=21.2± 1.9yr., mass=71.9±11.7kg, ht=174.3±6.9cm) and fifteen healthy subjects (6 males and 9 females, age=20.4±2.1yr., mass=73.1±13.4kg, ht=172.1±5.5cm) participated in the study. **Interventions:** Mechanical joint stability was measured with an instrumented ankle arthrometer. The arthrometer measured ankle joint motion for anterior/posterior translation and inversion/eversion angular displacement. All subjects also filled out the foot and ankle ability measure (FAAM) and the FAAM sports subscale. After initial testing, all subjects were provided with a Digi-Walker SW-200 pedometer (New Lifestyles, Inc., Lees Summit, Missouri). Participants were instructed to wear the pedometer everyday for seven days and complete the daily step log. Bivariate correlations using Pearson Product Moments were made between all dependent variables taken on the CAI and health ankles. The level of significance was set a priori at $p \leq 0.05$ for all analyses. **Main Outcome Measures:** Anterior displacement (mm), posterior displacement (mm), inversion rotation (°), eversion rotation (°), and average daily step count. **Results:** Subjects with CAI had significantly less steps (p=.04) compared to the healthy group. The average daily step count for the CAI group was 8,694.47±1,603.35 and for the healthy group 9,831.01 ±2,290.01. Subjects with CAI had significantly more (p = .001) anterior displacement (14.2mm ± 2.7) compared to the healthy ankles (10.6mm ± 1.8). There were no significant differences for posterior displacement or inversion/eversion rotation. Several significant bivariate correlations were identified. The strongest relationship was between anterior laxity and average daily step count (r = -.84, p < .02). As anterior displacement increased average daily step count decreased. There was also a significant relationship with inversion rotation and average daily step count (r = -.78, p< .047). As inversion rotation increased average daily step count decreased. **Conclusions**: The results of this study indicate increased laxity in those with CAI may contribute to the decreased physical activity levels of these subjects. It is unknown if the decreased step count is due solely to increased joint laxity or potentially the corresponding changes in neuromuscular control that occur with joint instability. Decreased physical activity levels in this population is a concern, and interventions need to be designed to improve ankle stability and neuromuscular control to ensure subjects can participate in physical activity/exercise programs.

Background

Ankle sprains are the most common injury associated with physical activity (1). Even more concerning is the high percentage of patients that re-sprain their ankle (up to 70%) and the development of CAI (up to 74%) (2). Long term, the development of CAI has been directly linked to post-traumatic ankle osteoarthritis (OA) development (3). Both CAI and ankle OA increase subjective disability and may lead to decreased physical activity levels (4,5). Physical inactivity is currently classified as one of the three highest risk behaviors in the development of cardiovascular disease, cancer, and other chronic diseases such as diabetes and obesity, and is the second highest alterable cause of cardiovascular arterial disease (6). Thus ankle sprains, while often viewed as mild injuries, may represent a significant public health problem and a major healthcare burden. However, currently we do not know the relationship between ankle sprains and physical activity levels in those with CAI.

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METHODS and MEASURES

Subjects: Fifteen subjects with unilateral CAI (6 males and 9 females, age=21.2± 1.9yr., mass=71.9±11.7kg, ht=174.3±6.9cm) and fifteen healthy subjects (6 males and 9 females, age=20.4±2.1yr., mass=73.1±13.4kg, ht=172.1±5.5cm) participated in the study. All subjects filled out an ankle instability questionnaire which established the criteria (Figure 1) for classifying subjects with CAI (7). Inclusion criteria included: previous history of unilateral ankle sprain, frequent giving way of the ankle, pain, feelings of instability, and decreased function. Additionally all subjects filled out the International Physical Activity Questionnaire (IPAQ) (Figure 2) and the Foot and Ankle Ability Measure (FAAM). Subjects were excluded from participation if they had incurred either of the following: an acute ankle sprain 6 weeks prior to participation in the study, history of surgery or fracture to either lower extremity, or any previous sprain to the ankle on the contralateral limb to the chronically unstable ankle. For the controls subjects, they needed to be free of previous musculoskeletal injury or surgery to either lower extremity.

Physical Activity Measurement. All subjects were provided with a Digi-Walker SW-200 pedometer (New Lifestyles, Inc., Lees Summit, Missouri). Participants were instructed to wear the pedometer everyday for seven days and complete the daily step log. Subjects were instructed to not change their typical routine and leisure activities during the study.

Figure 1. Ankle Instability Questionnaire

Name: _____

Ankle History Questionnaire

Have you ever sprained your ankle?
Yes / No
If yes, which one? Right / Left

Initial injury

How long ago did it occur?

Was your injury diagnosed by a physician? Yes / No

What was the diagnosis?

What was your course of treatment (crutches, PT, AT, immobilization)?

How long were you out of activity?

How many times have you sprained your ankle since your initial injury?

Recurrent Signs and Symptoms

Do you currently have "giving way", "rolling" or instability?
Yes / No
If yes, when and how often?

Do you have any of the following problems?
Feeling of instability during activity? Yes / No
Which activities?

Feeling of instability on uneven surfaces? Yes / No

Pain? Yes / No

Swelling? Yes / No

Weakness? Yes / No

Decreased function? Yes / No

Exclusion Criteria

Have you had an ankle sprain within the last 6 weeks? Yes / No

Have you ever had an ankle fracture? Yes / No

Have you ever had ankle surgery? Yes / No

Figure 2. International Physical Activity Questionnaire Sample

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities

How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities

How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**
_____ **minutes per day**

RESULTS

Statistical Analysis: All subject descriptive data was analyzed using a one-way analysis of variance (ANOVA) between groups (CAI, Healthy). A two-way ANOVA (group X sex) was used to determine any differences in the total number of weekly steps taken between groups and between males and females. Bivariate correlations using Pearson Product Moments were made between all dependent variables taken on the CAI and health ankles. An alpha-level of $p < 0.05$ was used to determine significant effects for each analysis.

Physical Activity Levels: There was no significant group x sex interaction (p=.08). There was a main effect for group (Table 1). Subjects with CAI had significantly less steps (p=.04) compared to the healthy group. The average step count for the CAI group was 8,694.47±1,603.35 and for the healthy group 9,831.01 ±1,290.01. Subjects with CAI also scored significantly less on the FAAM (p=.01) and FAAM sport scale (p=.01). There were no significant differences for posterior displacement or inversion/eversion rotation. Several significant bivariate correlations were identified. The strongest relationship was between anterior laxity and average daily step count (r = -.84, p < .02). As anterior displacement increased average daily step count decreased. There was also a significant relationship with inversion rotation and average daily step count (r = -.78, p< .047). As inversion rotation increased average daily step count decreased. Additionally, the subjects with CAI scored significantly less on "average time spent performing vigorous physical activity" (p = .01) and "average time spent performing moderate physical activity" (p = .03) compared to the healthy subjects. During an average 7 day week, CAI subjects reported being significantly less physically active by an average of 41.3 ± 13.4 minutes compared to those with no history of an ankle sprain.

Table 1

	CAI	Healthy
Weekly Steps*	8,694.47±1,603.35	9,831.01 ±1,290.01
FAAM*	88.45 ± 4.3	100 ± .00
FAAM Sport*	76.34 ± 10.6	98.7± .12
Moderate activity*	95.4 ± 24.6 minutes	136.4 ±35.6 minutes
Vigorous Activity*	72.2 ± 10.7 minutes	83.4 ± 05.4 minutes

Table 1: Mean (±SD) for dependent variables. * indicates significant difference ($p < 0.05$) between the CAI and Healthy Group

CONCLUSIONS

Based on the preliminary data presented in the current study subjects with CAI are less physically active then those with healthy ankles. Additionally, increased laxity in those with CAI may contribute to the decreased physical activity levels. It is unknown if the decreased step count is due solely to increased joint laxity or potentially the corresponding changes in neuromuscular control that occur with joint instability. Further research needs to be conducted in a larger sample and over a longer period of time. The long term consequences of decreased physical activity could lead to the development of numerous chronic diseases and therefore warrants further study to prevent their development.

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