Prevention and Rehabilitation of Ankle Sprains: From Research to Reality

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Acknowledgements

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RESEARCH TO REALITY

- Ankle sprains as a public health issue
- Etiology: Postural Control Gait
- Rehabilitation
  - Balance Training
- Prevention
  - Taping/Bracing
  - Balance Training
Ankle sprains accounted for 15% of all injuries in the 15 sports studied
- Annual estimate of 11,000 ankle sprains per year in NCAA athletes

Most common injury in:
- Basketball (M/W)
- W Gymnastics
- Lacrosse (M/W)
- Soccer (M/W)
- Softball
- W Volleyball

Second most common injury in:
- Baseball
- Field hockey
- Football
- Wrestling

2007; 42 (2)
Ankle Sprains as a Public Heath Issue

- Ankle sprains are extremely common in:
  - Sport and exercise
  - Military training
  - Occupational injuries
  - General population

- 1.6 million physician visits annually for ankle sprains in the US (AAOS, 1999)

- In 2006, more than 280,000 U.S. basketball, football, soccer, and volleyball high school athletes were treated in a physician’s office or emergency department facility for ankle sprains
  - Total costs: >$2 billion
  
Ankle Sprains: Public Heath Issue

- Recurrence rates >70% in basketball
  (Yeung et al, BJSM, 1994)

- 6 months post-injury, ~70% report residual symptoms
  (Braun, Arch Fam Med, 1999)

- 2 years post-injury, 74% reported at least one residual symptom
  - 47% reported perceived instability and more than one other symptom
  - Also rated lower general health quality of life (SF-36)
    compared to those with upper extremity joint injuries
    (Anandacoomarasamy & Barnsley, BJSM, 2005)

- 3 years post-injury:
  - ~25% report subjective instability
  - 5-25% report pain
  - 15-45% report lack of full recovery
  (van Rijn, Am J Med, 2008)

- Individuals with chronic symptoms after ankle sprains are
  less physically active over their lifespan than controls
  (Verhagen et al, 1995)
Ankle Sprains as a Public Heath Issue

- Most common predisposition to an ankle sprain is the history of a previous sprain (Beynnon et al, J Athletic Training, 2002)

- 55% of ankle sprains are not treated by a health care professional (McKay et al, BJSM, 2001)

- Chronic ankle instability (CAI)
  - Repetitive sprains and “giving way”
  - Persistent symptoms
  - Diminished self-reported function
  - Estimated prevalence ~30% (Hertel, J Athletic Training, 2002)

- Relationship between ankle sprain history and development of osteoarthritis (Valderrabano et al, AJSM, 2006)
Factors associated with anterior cruciate ligament injury history in female athletes

Kramer LC, Denegar CR, Buckley WE, Hertel J.

*J Sports Med Phys Fitness.*

2007; 47: 446-454.
# Ankle Sprain History & ACL Injury Risk?

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<th>Ankle Injury (YES)</th>
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<th>$\chi^2$</th>
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<td>27</td>
<td>61</td>
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<tr>
<td>% of Injury</td>
<td>34/61 = 56%</td>
<td>27/61 = 44%</td>
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<td>5.97</td>
<td>.02*</td>
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<td>27</td>
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<tr>
<td>% of No Injury</td>
<td>12/39 = 31%</td>
<td>27/39 = 69%</td>
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ETIOLOGY: MECHANISM OF INJURY

- Supination of the rearfoot coupled with external rotation of the lower leg
  - Plantar flexion
  - Inversion
  - Internal Rotation

- More plantar flexion and inversion at initial contact increases likelihood of a sprain (Wright et al, J Biomech, 2000)
PATHOMECHANICAL MODEL OF ACUTE SPRAIN

- Vertical ground reaction force medial to the subtalar axis of rotation will cause a “supination moment” (Fuller, J Am Podiatric Med Assoc, 1999)
- If supination moment exceeds pronation moment, potential for injury exists.
THE CRITICAL PERIODS: Terminal Swing & Initial Contact

- Position of the foot at initial contact dictates ground reaction forces.
- If the foot is inverted too far at initial contact, injury mechanism is inevitable.
What makes a stable joint?

1. **Ligaments**
2. **Muscles & Tendons**
3. **Bony Stability**

**Central Nervous System (CNS)**

**Joint Stability**

- **Afferent Signals**
- **Efferent Signals**
CHRONIC ANKLE INSTABILITY: TRADITIONAL PARADIGM

- Mechanical Instability
  - Pathological Laxity

- Functional Instability
  - Proprioceptive and neuromuscular deficits
Chronic Ankle Instability

Mechanical Insufficiencies
- Arthrokinematic Restrictions
- Pathological Laxity
- Degenerative Changes
- Synovial Changes

Functional Insufficiencies
- Impaired Proprioception
- Impaired Neuromuscular Control
- Impaired Postural Control
- Strength Deficits

Recurrent Ankle Sprain

Hertel, J Athletic Training, 2002
SPECTRUM OF FUNCTIONAL ANKLE INSTABILITY MEASURES

Motoneuron Pool Excitability
Proprioception
Reflex Reactions
Strength
Postural Control
Walking Mechanics
Running Mechanics
Jumping & Landing Mechanics
Cutting Mechanics

Passive ................................................................. Active
Sensory ................................................................. Motor
Experimental Control ........................................... Athletic Function
Hertel J, Buckley WE, Denegar CR.

Serial testing of postural control after acute lateral ankle sprain

Journal of Athletic Training

36: 363-368, 2001
Postural Control Methods

- Single leg stance trials for 5 to 30 seconds on force plate

- “Stand as still as possible”

- Center of pressure (COP) excursion root mean square (RMS) velocity is dependent measure
Eyes Open COP Velocity after Ankle Sprain

Day after Ankle Sprain

n=17; side by plane by session interaction
p=0.01
Evans TA, Hertel J, Sebastianelli WJ.

Bilateral postural control deficits after unilateral ankle sprain

Foot & Ankle International

2004; 25: 833-839
Eyes Open COP Velocity after Ankle Sprain

**Graph:**
- **Y-axis:** COP Velocity (cm/s)
- **X-axis:** Day (Baseline, 2 or 3, 7, 14, 21, 28)

**Lines:**
- Injured
- Uninjured

**Legend:**
- Side: p=0.04
- Session: p=0.02
- n=27
Hertel J, Olmsted LC.

Deficits in time-to-boundary measures of postural control with chronic ankle instability.

Gait & Posture
Time to Boundary Calculations in the Frontal Plane

\[ V_{\text{copx1}} = \frac{d_{\text{copx1}}}{0.02\text{s}} \]

\[ \text{TTBX}_1 = \frac{d_{\text{bound1}}}{V_{\text{copx1}}} \]
# RESULTS

## Time-To-Boundary Measures

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<th>Side x Group Interaction (p)</th>
<th>Side Main Effect (p)</th>
<th>Group Main Effect (p)</th>
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Between factor: Group (CAI, Healthy)  
Within factor: Side (Involved, Uninvolved)
# RESULTS - Traditional Measures

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<th>Side x Group Interaction (p)</th>
<th>Side Main Effect (p)</th>
<th>Group Main Effect (p)</th>
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<tr>
<td>Frontal COP Velocity</td>
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<td>.73</td>
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<tr>
<td>Sagittal COP Velocity</td>
<td>.35</td>
<td>.70</td>
<td><strong>.05</strong></td>
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<tr>
<td>Frontal COP SD</td>
<td>.07</td>
<td>.16</td>
<td>.40</td>
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<td>Sagittal COP SD</td>
<td>.29</td>
<td>.70</td>
<td>.74</td>
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<tr>
<td>Frontal COP Range</td>
<td>.23</td>
<td>.12</td>
<td>.82</td>
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<td>Sagittal COP Range</td>
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<td>.74</td>
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<tr>
<td>Frontal COP Range Used</td>
<td>.25</td>
<td>.13</td>
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<tr>
<td>Sagittal COP Range Used</td>
<td>.21</td>
<td>.69</td>
<td>.25</td>
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</table>

Between factor: Group (CAI, Healthy)
Within factor: Side (Involved, Uninvolved)
TTB SUMMARY

- 5 of 6 time-to-boundary measures showed statistically significant impairment in CAI group
  - Main effects for group indicate bilateral impairments in postural control associated with CAI

- Less time-to-boundary measures among CAI subjects due to increased postural unsteadiness

- Less variability in time-to-boundary profile of CAI subjects
  - Similar to results found in bilateral stance of Parkinson’s patients and elderly subjects
  - Lack of variability in postural control strategy may be related to decreased ability to adequately react to postural perturbations
Star Excursion Balance Tests

Gray, 1995

Kinzey & Armstrong, JOSPT, 1998

Hertel et al., J Sport Rehab., 2000
Efficacy of the Star Excursion Balance Test in detecting balance deficits in subjects with chronic ankle instability

Journal of Athletic Training
Star Excursion Balance Test

Distance Reached (cm)

- Injured
  - CAI: 82.8
  - Control: 83.2
- Uninjured
  - CAI: 78.6
  - Control: 81.2

n=40
Side by group interaction
p=0.05
CLINICAL IMPLICATIONS

- Performance of all 8 reach directions of SEBT is unnecessary when evaluating for functional deficits related to CAI.
Contributing factors to chronic ankle instability

Foot and Ankle International

### Mechanical Measures
- Anterior laxity (mm)
- Posterior laxity (mm)
- Inversion laxity (°)
- Eversion laxity (°)
- Fibular position (mm)
- Posterior talar glide (°)

### Functional Measures
- Plantar flexion peak torque (N.m)
- Dorsiflexion peak torque (N.m)
- Inversion peak torque (N.m)
- Eversion peak torque (N.m)
- Plantar flexion average power (N.m/sec)
- Dorsiflexion average power (N.m/sec)
- Inversion average power (N.m/sec)
- Eversion average power (N.m/sec)
- PF:DF peak torque ratio
- PF:DF average power ratio
- Inversion:Eversion peak torque ratio
- Inversion:Eversion average power ratio
- Hip abduction force
- Hip extension force
- Passive hip adduction (°)
- Tibial Varum (°)
- Knee Hyperextension (°)
Measures best discriminating between subjects CAI and Control groups

- Inversion laxity ($r^2\Delta = .20$)
- Anterior laxity ($r^2\Delta = .11$)
- Failed balance trials with eyes closed ($r^2\Delta = .09$)
- Plantar flexion:dorsiflexion peak torque ratio ($r^2\Delta = .05$)
  - CAI group had weaker PF in relation to DF

Model containing these 4 factors:
- Explained 45% of variance between CAI and control groups
- Correctly predicted group membership for:
  - 87% of CAI subjects
  - 87% of healthy subjects

Clinical implications – Mechanical instability
- Do clinicians consider restoration of pre-injury joint laxity a goal in the treatment of an acute ankle sprain?
Measures best discriminating between limbs in subjects with unilateral CAI

- Anterior reach of SEBT ($r^2\Delta = .19$)
- Plantar flexion peak torque ($r^2\Delta = .10$)
- Posteromedial reach of SEBT ($r^2\Delta = .09$)
- Inversion laxity ($r^2\Delta = .04$)

Model containing these 4 factors:
- Explained 42% of variance between CAI and healthy limbs
- Correctly predicted group membership for:
  - 80% of CAI limbs
  - 73% of healthy limbs

Clinical implications – Functional instability
- Do clinicians rehabilitate patients recovering from acute ankle sprains long (and well) enough to restore balance and strength to pre-injury levels?
Altered Kinematics During Gait Associated with Chronic Ankle Instability

Hertel J, Lee SY, McKeon PO, Kerrigan DC.

(new data)
Methods: Cohort Study

- **Independent variable: Group**
  - **Chronic Ankle Instability (CAI)** (n=29)
    - History of at least one lateral ankle sprainings
      - (6.1 ± 4.3 prior sprains)
    - Repetitive ankle “giving way” during functional activities
    - <80% function on Foot and Ankle Disability Index (FADI) sport scale
      - 65.5 ± 9.9%
  - **Copers** (n=12)
    - History on lateral ankle sprain >12 months ago
    - No reports of “giving way
    - FADI Sport Scale score >95%
  - **Control** (n=12)
    - No history of lateral ankle sprain

- **Dependent variables in walking and jogging:**
  - Rearfoot inversion/eversion kinematics
  - Ankle plantar flexion/dorsiflexion kinematics
  - Tibial internal/external rotation kinematics
Methods: Procedures

- Anthropomorphic measurements
- Position marker set
- Static calibration trials
- Three, 15-second trials walking at 3mph
- Three, 15-second trials jogging at 6mph
CAI vs. Controls
Inversion-Eversion ROM: Jogging

Mean Difference = $5.4^\circ \pm 1.2^\circ$
CAI vs. Copers
Inversion-Eversion ROM: Jogging

Mean Difference = 5.2° ± 1.6°
CAI vs. Controls
Dorsi-Plantar Flexion ROM: Jogging

Mean Diff = 5.4° ± 1.4°
Mean Diff = 5.6° ± 1.6°
Controls vs. Copers
Dorsi-Plantar Flexion ROM: Jogging

Mean Diff = 2.7° ± 1.8°

Mean Diff = 5.6° ± 1.8°
Summary of Kinematic Differences

- **Jogging**
  - CAI group significantly more inverted than controls and copers during late stance and all of swing.

  - CAI and coper groups significantly more plantar flexed than controls during late stance, early swing, late swing, and at initial contact.
Effect of balance training on postural control, gait, and function in those with chronic ankle instability

New Data
Subjects

- 31 adults (12 males, 19 females) with self-reported CAI
  - < 90% on FADI and FADI Sport
  - No ankle sprains for six weeks
  - No history of lower extremity injury within the past six months

- Balance Training Group (6 males and 10 females)
  - Age: 22.2±4.5 years, Height: 168.9±7.7 cm, Mass: 63.0±8.8 kg
  - 6.3 ± 7.1 previous sprains (10.7 ± 7.0 months since the last sprain)
  - 85.5±8.4% (FADI) and 69.9+12% (FADI Sport)

- Control group (6 males and 9 females)
  - Age: 19.5±1.2 years, Height: 173.1cm, Mass: 67.3 kg
  - 4.6 ± 2.5 previous sprains (5.5 months since the last sprain)
  - 82.9 ± 7.4% (FADI) and 66.4±9.8% (FADI Sport)
Balance Training Program

- 4-week balance training program
  - 3 days/week (12 Sessions)
  - 100% compliance

- Tasks designed to challenge sensorimotor system to recover single limb stance during functional activities
  - Hop to stabilization
  - Hop and reach
  - Unanticipated hop to stabilization
  - Single limb stance eyes open and closed

- Purposeful manipulation of task and environmental constraints
  - As subjects progressed error free, task and environmental constraints were increased
Hop to Stabilization
Hop to Stabilization and Reach
Single Limb Stance Eyes Open
Single Limb Stance Eyes Closed
Unanticipated hop to stabilization
Self-Reported Function

= Balance Training

= Control

Interation, p = .03

Post hoc Test, p<0.05, ES = .98
Post hoc Group, p<0.05, ES = .63

Interation, p = .009

Post hoc Test, p<0.05, ES = 1.25
Post hoc Group, p<0.05, ES = 1.63
Star Excursion Balance Test

PRETEST POSTTEST

Normalized PM Reach Distance

PRETEST POSTTEST

Normalized PL Reach Distance

= Balance Training

= Control

* = Post hoc Test, p<0.05, ES = .64
† = Post hoc Group, p<0.05, ES = 1.83

* = Post hoc Test, p<0.05, ES = .67
† = Post hoc Group, p<0.05, ES = 1.0
Mean of TTBAP Minima

- **Balance Training**
- **Control**

**Mean of TTBAP Minima (s)**

- * = Post hoc Test, p<0.05, ES = .41
- †† = Post hoc Group, p<0.05, ES = .32
Balance Training Group: Inversion/Eversion Walking

Significant differences found within window of 33-55% of gait cycle. Mean Difference = 3.1°±.05° more everted after balance training.
Balance Training Group: Inversion/Eversion Jogging

Balance training group more everted after training
PROPHYLACTIC ANKLE TAPING AND BRACING: A Numbers-Needed-To-Treat And Cost-Benefit Analysis

Olmsted LC, Vela LI, Denegar CR, Hertel J.

*J Athletic Training, 2004; 39: 95-100*
Clinical Epidemiology Terms

- **Absolute risk reduction** (or increase)
  - The absolute arithmetic difference in event rates between experimental and control groups
  - $ARR = \frac{\text{Control group event rate} - \text{Experimental group event rate}}{}$

- **Numbers Needed to Treat** (to benefit)
  - The inverse of the absolute risk reduction.
  - $NNT = \frac{1}{ARR}$

- **Numbers Needed to Treat to Harm**
  - This is calculated in the same way as for NNT, but used to describe adverse events.
  - $NNH$ represents the number of patients that need to be treated for one to suffer an adverse event compared with a control.

- 2562 intramural basketball players at the University of Washington from 1972-1973
- Intervention: ankle taping

**History of previous sprain**
- Control: 24 sprains/434 exposures = .0553
- Taping: 13 sprains/794 exposures = .0164
- NNT = 26 (95% CI = 17 to 81)

**No History of previous sprain**
- Control: 12 sprains/670 exposures = .0179
- Taping: 4 sprains/367 exposures = .0109
- NNT = 143 (95% CI = 127 NNTB to ∞ to 39 NNTH)
Sitler et al., AJSM, 1994

- 1601 intramural basketball cadets at the USMA in West Point, NY from 1990-1991
- Intervention: Ankle bracing
  (Aircast Sports Stirrup)

**History of previous sprain**
- Control: 6 sprains/90 subjects = .067
- Bracing: 1 sprain/87 subjects = .011
- NNT = 18 (95% CI = 8 NNTB to ∞ to 60 NNTH)

**No History of previous sprain**
- Control: 29 sprains/722 subjects = .040
- Bracing: 10 sprains/702 subjects = .014
- NNT = 39 (95% CI = 23 to 128)
504 male soccer players from 4 divisions in the Western Province of South Africa

Intervention: Ankle bracing (Aircast Sports Stirrup)

**History of previous sprain**
- Control: 42 sprains/131 subjects = .321
- Taping: 16 sprains/127 subjects = .126
- **NNT = 5 (95% CI = 3 to 10)**

**No History**
- Control: 33 sprains/129 subjects = .256
- Taping: 32 sprains/117 subjects = .274
- **NNT = 57 (95% CI = 8 NNTB to ∞ to 11 NNTH)**
Clinical Applications

- Taping and bracing are beneficial in reducing the incidence of ankle sprains in people WITH a previous history of sprain.

- Bracing offers a more cost- and time-effective preventative measure than taping.
SYSTEMATIC REVIEW OF POSTURAL CONTROL & LATERAL ANKLE INSTABILITY:

PART 1: CAN DEFICITS BE DETECTED WITH INSTRUMENTED TESTING?

PART 2: IS BALANCE TRAINING CLINICALLY EFFECTIVE?

McKeon PO, Hertel J.

Journal of Athletic Training

(in press)
CLINICAL QUESTIONS

1) Is poor postural control associated with increased risk of suffering a first time ankle sprain?

2) Can prophylactic balance training reduce the risk of ankle sprain?

3) Is postural control adversely affected after acute ankle sprain?

4) Can balance training improve treatment outcomes after acute ankle sprain?

5) Is postural control adversely affected with chronic ankle instability?

6) Can balance training improve treatment outcomes in those with chronic ankle instability?
SEARCH STRATEGY

- Pubmed, CINAHL 1966-2006
  - Cross-references from reference lists of identified articles

- Limits: English, Humans

- Search terms:
  - Ankle instability
  - Ankle sprain
  - Balance
  - Chronic ankle instability
  - Functional ankle instability
  - Postural control
  - Postural sway

- Identified over 100 articles
  - Selected those that addressed at least one of our 6 questions via original research

- Postural control measurement must have been modified Rhomberg test on a stable force platform

- Provided a total of 42 included articles (not all shown today)

- Included studies were assessed for quality using the Pedro scale
Clinical Epidemiology Terms

- **Odds Ratio** - ratio of the odds of having the target disorder in the experimental group relative to the odds of having the target disorder in the control group.

- **Formula**
  - \( \text{OR} = \frac{\text{Experimental group event rate}}{\text{Control group event rate}} \)
  - or
  - \( \text{OR} = \frac{\text{Control group event rate}}{\text{Experimental group event rate}} \)

- **Interpretation**
  - \( \text{OR}=1 \) implies that the event is equally likely in both groups.
  - \( \text{OR}>1 \) implies that the event is more likely in the first group (numerator).
  - \( \text{OR}<1 \) implies that the event is less likely in the first group (numerator).
Does poor postural control increase risk of ankle sprain?

Decreased Risk of Sprain  
Increased Risk of Sprain

Pathologic Stabilometry Score vs. Nonpathologic
High-Sway Velocity vs. Midrange-Sway Velocity
Midrange-Sway velocity vs. low sway velocity
High-Sway Velocity vs. Low-Sway Velocity
AP Postural Sway Variability
ML Postural Sway Variability

Odds Ratio

0.1  1  10  100
Is poor postural control associated with increased risk of suffering a first time ankle sprain in athletes?

- Yes

- SORT Level of Evidence: 1
  - Systematic review showing some inconsistent findings

- SORT Grade of Recommendation: B
CLINICAL IMPLICATIONS

- Prospective postural control testing may help identify athletes at an increased risk of ankle sprain.

- Findings based on a fairly heterogeneous population:
  - Gender
  - Age
  - Sport
Clinical Epidemiology Terms

- **Relative Risk**
  - The ratio of risk in the experimentally treated group (EER) to risk in the control group (CER)
  - \( RR = \frac{\text{Experimental group event rate}}{\text{control group event rate}} \)

- **Relative Risk Reduction** (or increase)
  - the percentage that the experimental treatment reduces risk compared to the control
  - \( RRR = (1-RR) \times 100 \)
Can prophylactic balance training reduce the risk of ankle sprain?

Relative Risk Reduction

- Bahr et al.\textsuperscript{15} 1st Year
- Bahr et al.\textsuperscript{15} 2nd Year
- McGuine et al.\textsuperscript{16} All Participants
- McGuine et al.\textsuperscript{16} No History
- McGuine et al.\textsuperscript{16} Previous History
- Verhagen et al.\textsuperscript{17} All subjects
- Verhagen et al.\textsuperscript{17} Previous History

Graph showing the relative risk reduction with different studies and conditions.
Can prophylactic balance training reduce the risk of ankle sprain?

Numbers Needed to Treat

- **Bahr et al.**
  - 1st Year
  - 2nd Year

- **McGuine et al.**
  - All participants
  - No History
  - Previous History

- **Verhagen et al.**
  - All participants
  - No History
  - Previous History

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<td>1</td>
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<td>Harm</td>
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Verhagen et al, 2004

- Further analysis of those with and without prior history of ankle sprain
- Intervention was significantly more effective in those with a previous hx
- There was not a significant reduction in injuries in those without prior ankle injury
Can prophylactic balance training reduce the risk of ankle sprain?

- Yes
  - Especially in those with a previous history of ankle sprain

- SORT Level of Evidence: 1
  - Two high quality RCT showing conclusive results
  - Systematic review showing other lower quality studies with mostly consistent findings

- SORT Grade of Recommendation: B
CLINICAL IMPLICATIONS

- Postural control training may help reduce the risk of ankle sprain
  - Especially in those with a history of prior sprain

- Findings based on a heterogeneous population
  - Volleyball
  - Basketball
  - Soccer
  - Both sexes
Is postural control affected after ankle sprain?

Injured Side – Group Differences

- Sway Index
- Day 14 Sway Index
- Day 7 Sway Index
- Day 3 Sway Index
- ML Excursions > 10mm
- ML Excursions > 5mm
- Mean ML COP Amplitude
- ML COP Velocity
- ML COP Standard Deviation

Effect Size

Control group worse

Injured group worse
Is postural control affected after ankle sprain? Injured vs. Uninjured Side

Figure 5.
Postural control is adversely affected after acute ankle sprain and improvement of postural control should be considered when designing treatment goals.
Does balance training after acute sprain reduce the risk of recurrent ankle sprain?

Relative Risk Reduction

Holme et al.\textsuperscript{19}

Wester et al.\textsuperscript{20}

Increased Risk of Reinjury

Relative Risk Reduction (\%) Decreased Risk of Reinjury
Can balance training after acute ankle sprain reduce the risk of recurrent sprain?

Numbers Needed to Treat
Can balance training improve treatment outcomes after acute ankle sprain?

- Yes
  - The risk of re-injury can be significantly reduced, but
  - Measures of postural control lack precision to show consistent improvement in postural control with balance training

- SORT Level of Evidence: 2
  - Two medium-quality RCTs showing fairly conclusive results
  - The injury prevention effects are consistent, but the postural control measures are not

- SORT Grade of Recommendation: B
CLINICAL IMPLICATIONS

- Postural control training after acute ankle sprains appears to substantially reduce the risk of re-injury
Is Postural Control Adversely Affected by Chronic Ankle Instability?

Group Differences

Control Group Worse  Effect Size  CAI Group Worse

-6  -4  -2  0  2  4  6  8

- Stable Sway Index
- Movements > 175°
- Total Horizontal Sway Velocity
- AP Sway Velocity
- ML Sway Velocity
- EC Static Sway Index
- EO Static Sway Index
- EC COP Area
- EO COP Area
- EC COP Velocity
- EO COP Velocity
- ML COP Velocity
- AP COP Velocity
- ML COP Range
- AP COP Range
- ML COP Standard Deviation
- AP COP Standard Deviation
Is Postural Control Adversely Affected by Chronic Ankle Instability? Side-Side Differences
Is postural control adversely affected with chronic ankle instability?

- Not clear
  - Moderate to large effect sizes are found between CAI and control groups, but confidence intervals are very wide
  - Comparisons between involved and uninvolved limbs reveal weak effect sizes

- SORT Level of Evidence: 2
  - Systematic review of lower quality studies with inconsistent findings

- SORT Grade of Recommendation: B
CLINICAL IMPLICATIONS

- Postural control deficits cannot be consistently detected in patients with CAI using traditional measures.
Can balance training improve treatment outcomes in those with chronic ankle instability? Group Differences
Does balance training in those with CAI reduce the risk of recurrent ankle sprain?

- Eils and Rosenbaum reported a 60% decrease in episodes of the ankle “giving way” in those with CAI who completed a supervised rehabilitation program, however data not reported to allow for calculation of RR or NNT.

- No other authors reported re-injury rates.
Can balance training improve treatment outcomes in those with chronic ankle instability?

- Not clear
  - Measures of postural control lack precision to show consistent improvement in postural control with balance training
  - The risk of re-injury may be reduced but there is insufficient data to support this conclusion at this time

- SORT Level of Evidence: 2
  - Two medium-quality cohort studies and one pre-post study showing inconclusive results

- SORT Grade of Recommendation: B
It is unclear if postural control training improves treatment outcomes for patients with chronic ankle instability.
1) Is poor postural control associated with increased risk of suffering a first time ankle sprain? YES

2) Can prophylactic balance training reduce the risk of ankle sprain? YES

3) Is postural control adversely affected after acute ankle sprain? YES

4) Can balance training improve treatment outcomes after acute ankle sprain? YES

5) Is postural control adversely affected with chronic ankle instability? INCONCLUSIVE

6) Can balance training improve treatment outcomes in those with chronic ankle instability? INCONCLUSIVE
Conclusions: Research to Reality

- Ankle sprains are a public health problem
- We have done a thorough job of identifying neuromuscular differences between individuals with and without CAI
- Taping and bracing appear to be effective in reducing the risk of recurrent ankle sprains in males
- Balance training is effective at reducing the risk of recurrent ankle sprain
- The risk of recurrent ankle sprain is greatest within one year of previous sprain
  - This is the critical time for injury prevention!