Addressing Proximal Strength in the Management of Chronic Ankle Instability

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No disclosures
Background

- Lateral ankle injuries are the most common in athletic activities
- 16-21% of athletic injuries
- 28,000 ankle sprains occur daily

Background

- Some patients have prolonged or recurrent symptoms following initial injury.
- Clinicians spend valuable time in treating these recurrent injury and symptoms.
- Treatment strategies vary based on patient deficits.
Background

- Residual symptoms may include a feeling of “giving way” which is key factor in identification of Functional Ankle Instability (FAI) (Freeman, 1965).
  - Currently referred to as Chronic Ankle Instability (CAI)

- Individuals with CAI have deficits in proprioception, strength, and self-reported function (Arnold, Wright, & Ross, 2011; Hertel, 2000; Hertel, 2002).

- Individuals with CAI demonstrate hip weakness (Powers et al. 2004)
Background

- Proprioception and Neuromuscular Control
  - Force sense; Joint position sense; Kinesthesia
    - Contributes to Postural Control (Balance) (Riemann & Lepart, 2002)
      - Static Balance
      - Dynamic Balance

- Strength training effects neural factors (Moritani & DeVeries, 1979)
  - Ankle strengthening improves ankle joint position sense (Docherty, Moore, & Arnold, 1998)
Failing Rehabilitation

- Talar Tilt Stress Radiograph
Failing Rehabilitation

- Anterior Drawer Stress Radiograph

> 5 mm
Ankle Instability Paradigm (MAI vs. FAI)
Modified Brostrom
Arthrobrostrom
Current Trends

- CAI rehab protocols focus on ankle components despite multi-joint functions
  - 4-way ankle Theraband exercises

- Hip joint utilized during closed kinetic chain activities including postural control
  - Effect balance assessments

- Hip strengthening incorporated to address knee pathology (Ferber, Kendall, & Farr, 2011; Khayabashi et al. 2012)
  - Well established protocols for PFPS and ACL injury prevention
EBM and patient care

- EBP is the “tip of the iceberg” regarding patient care.
- EBP can be as overwhelming as the copious amount of research.
EBM and patient care

- EBP is the product and optimal practice approach
- Outcomes are the mechanism
- Disablement models are the Framework
Significance

- Adequate physical rehabilitation for CAI can improve quality of life
  - Improving hip strength can improved postural control
  - Reducing postural control deficits can improve symptoms associated with CAI
  - Improving symptoms of CAI can improve quality of life
Methods

- **Research Design**
  - Randomized controlled clinical trial

- **Study Participants**
  - 26 college aged subjects
    - Training group
      - 6 men, 7 women
    - Control group
      - 6 men, 7 women
  - Physically active
  - Unilateral FAI according to two discriminative tools
CAI Discrimination and EBM

- Ankle Instability Instrument - valid and reliable; history of later ankle sprain, giving way during at least 2 of 4 conditions
  (Docherty, Gansneder, Arnold, & Hurwitz, 2006)

- Cumberland Ankle Instability Tool - valid and reliable; 9-item, 30 point scale assessing severity of FAI; threshold score is 27.5
  (Hiller, Refshauge, Bundy, Herbert, & Kilbreath, 2006)

- Combination of All and CAIT most accurate
  (Donahue, Simon, & Docherty, 2011)
## Participant Demographics

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n = 13) Mean (SD), Minimum - Maximum</th>
<th>Training Group (n = 13) Mean (SD), Minimum - Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>20.9 (1.26), 19.0 – 23.0</td>
<td>20.1 (1.69), 18.0 – 25.0</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>171.0 (13.6), 152.0 – 194.0</td>
<td>164.5 (12.3), 153.5 – 194.0</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>76.554 (17.97), 54.0 – 121.6</td>
<td>78.51 (17.78), 56.2 – 118.8</td>
</tr>
</tbody>
</table>
Procedures

- Demographic data collected

- Pre-testing for all subjects (counterbalanced)
  - Foot and Ankle Ability Measure
  - Balance Error Scoring System
  - Star Excursion Balance Test
  - Hip strength
    - External Rotation
    - Abduction

- Participants were randomly assigned to either training or control group after meeting criteria
Self-Reported Function

- **Foot and Ankle Ability Measure** - reliable and valid for subjects with instability (Carcia, Martin, & Drouin, 2008)
  - Activities of Daily Living Subscale
    - 21-item 5-point Likert scale
  - Sport subscale
    - 8-item 5-point Likert scale

- Higher score represent a higher level of function
Static Balance Assessment

- **Balance Error Scoring System (BESS)**
  (Riemann, Guskiewicz & Shields, 1999)
  - 3 stances on 2 surfaces

- Reliable and valid for screening static balance in individuals with FAI  
  (Dochtery, Valovich McLoed, & Shultz, 2006)
Dynamic Balance Assessment

- Star Excursion Balance Test
  (Kinzey & Armstrong, 1998)

  Reliable and valid for screening dynamic balance in individuals with ankle instability (Olmstead, Carcia, Hertel, & Shultz, 2002)
Hip Strength Assessment

- **Hand-held dynamometer**
  - Reliable for hip strength assessment
    (Thorborg, Petersen, Magnusson, & Holmich, 2010)
    - External Rotation
    - Abduction
Strength Training Procedures

- **Training Group**: Theraband supervised 4 weeks, 3 times per week
  - External Rotation
  - Abduction

- **Control Group**: no change to previous activity

- **Post-test**: Same protocol as pre-test
Hip ER Strengthening Protocol

<table>
<thead>
<tr>
<th>Week</th>
<th>Tubing</th>
<th>Sets x Reps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Green</td>
<td>3x20</td>
</tr>
<tr>
<td>2</td>
<td>Blue</td>
<td>3x20</td>
</tr>
<tr>
<td>3</td>
<td>Black</td>
<td>3x20</td>
</tr>
<tr>
<td>4</td>
<td>Silver</td>
<td>3x20</td>
</tr>
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## Hip Abduction Strengthening Protocol

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<td>4</td>
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</table>
Strength dependent variables- two separate Repeated Measures Analysis of Variance (RMANOVA) was conducted

- One within factor (test: pre and post) and one between factor (group: training and control).

FAAM-ADL and FAAM-sport scores dependent variables-a RMANOVA to analyze the primary outcome indicators

- One within factor (test: pre and post) and one between factor (group: training and control).
BESS dependent variable, a RMANOVA was conducted

- One between factor (group: training and control) and one within factor (test: pre and post) for the total error scores.

Three directions (anterior, posteriomedial, posteriolateral) of the SEBT dependent variable, a RMANOVA was conducted

- between factor (group: training and control) and within factors (test: pre and post).
Results

- Primary findings indicate that the hip strengthening protocol:
  - Increases hip strength in abduction and external rotation directions
  - Improves dynamic balance as measured by the SEBT
  - Improves static balance as measured by the BESS
  - Improve self-reported function as measured by the FAAM
## Strength Testing

<table>
<thead>
<tr>
<th></th>
<th>Pretest (N)</th>
<th>Post-test (N)</th>
</tr>
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<tbody>
<tr>
<td><strong>Abduction strength</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>360.1 ± 71.7</td>
<td>446.3 ± 77.4†</td>
</tr>
<tr>
<td>Control group</td>
<td>313.7 ± 56.9</td>
<td>314.7 ± 49.6</td>
</tr>
<tr>
<td><strong>External rotation strength</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>173.5 ± 36.9</td>
<td>222.1 ± 48.7†</td>
</tr>
<tr>
<td>Control group</td>
<td>166.6 ± 40.5</td>
<td>169.4 ± 34.6</td>
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## Neuromuscular Control

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Post-test</th>
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<tbody>
<tr>
<td><strong>BESS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>$23.92 \pm 9.1$ errors</td>
<td>$9.9 \pm 6.3$ errors†</td>
</tr>
<tr>
<td>Control group</td>
<td>$22.77 \pm 6.1$ errors</td>
<td>$21.15 \pm 6.3$ errors</td>
</tr>
<tr>
<td><strong>SEBT-A</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>$85.7 \pm 8.6$ cm</td>
<td>$93.1 \pm 7.4$ cm†</td>
</tr>
<tr>
<td>Control group</td>
<td>$89.2 \pm 7.6$ cm</td>
<td>$90.2 \pm 7.8$ cm</td>
</tr>
<tr>
<td><strong>SEBT-PM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>$83.9 \pm 10.9$ cm</td>
<td>$96.3 \pm 8.9$ cm†</td>
</tr>
<tr>
<td>Control group</td>
<td>$86.0 \pm 9.8$ cm</td>
<td>$88.0 \pm 8.8$ cm</td>
</tr>
<tr>
<td><strong>SEBT-PL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>$83.0 \pm 14.1$ cm</td>
<td>$95.4 \pm 11.1$ cm†</td>
</tr>
<tr>
<td>Control group</td>
<td>$84.4 \pm 10.6$ cm</td>
<td>$86.6 \pm 9.6$ cm</td>
</tr>
</tbody>
</table>
## Self-reported Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Pretest (%)</th>
<th>Post-test (%)</th>
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</thead>
<tbody>
<tr>
<td><strong>FAAM-ADL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>85.9 ± 11.7</td>
<td>92.4 ± 12.3</td>
</tr>
<tr>
<td>Control group</td>
<td>91.6 ± 7.8</td>
<td>93.8 ± 6.9</td>
</tr>
<tr>
<td><strong>FAAM-Sport</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training group</td>
<td>72.1 ± 16.8</td>
<td>88.0 ± 10.9 †</td>
</tr>
<tr>
<td>Control group</td>
<td>84.6 ± 9.2</td>
<td>84.8 ± 10.9</td>
</tr>
</tbody>
</table>

† Indicates a statistically significant difference compared to the training group.
Effects on Strength

- Proximal muscle strengthening improves balance and postural control
  - Abdominal training (Gage, 2009)
  - Hip strengthening (Piegaro, 2003)

- Hip strengthening increases hip strength is in agreement with previous research (Dolak, et al., 2011; Khayabashi, et al., 2012; Leavey, et al., 2010; Willy & Davis, 2011).

- Our strength increases were less than other studies

- Speculation that longer protocol produces greater gains
Effects on Neuromuscular Control

- In agreement with previous literature demonstrating proprioceptive improvements following strengthening (Blackburn, et al., 2000; Docherty, et al., 1998)
- Hip strengthening improving static and dynamic balance in agreement with previous research (Leavey, et al., 2010; Saxena, et al., 2012)
Effects on Self-reported Outcomes

- In agreement with previous studies demonstrating interventions improve outcomes for individuals with FAI (Hale, et al., 2007; Rozzi, et al., 1999; Schaefer & Sandrey, 2012).
- In agreement seeing improved outcomes following hip strengthening provides improvement
  - PFPS (Khayabaski, et al., 2012)
Conclusion

- The 4-week hip strength training protocol increased hip strength in participants with chronic ankle instability.
- The protocol also improved static and dynamic balance.
- Hip strengthening improves sport related self-reported function in participants with CAI.
- It is still unclear if hip strengthening can improve functions related to activities of daily living in individuals with CAI.
- Clinical practice should incorporate proximal muscle strengthening for individuals with CAI.


Thank you