Biomechanical effects of Long-Term Bracing of Ankle Injuries in Basketball Players

Jenna LaColla and Rachel Slappy
Tickle College of Engineering
Department of Mechanical, Aerospace, and Biomedical Engineering
Significance

- Ankle injuries alone account for over half of missed playing time among basketball players.
- Athletes who have sustained an ankle injury are up to five times more likely to experience the same injury again.
- Ankle injuries for females and males are 13.6 and 6.94 in every 1,000 exposures, respectively, and with a confidence level of 95%.
- Bracing is a common method of treatment and prevention, but often players will become dependent on ankle bracing for the remainder of their careers.
Normal Ankle Anatomy

- Joint is comprised of lower leg and foot
- Includes three major bones: tibia, fibula, and talus
- 12 muscles facilitate movement within the joint
- Many lateral and medial tendons

*HealthCommunities
Normal Ankle Biomechanics

- Shock absorber, flexible when deforming to uneven surfaces, but rigid during toe off
- Gait kinematics used commonly to analyze ankle biomechanics
Anatomy of an Ankle Sprain

Lateral ankle sprain

Normal  Grade I sprain  Grade II sprain  Grade III sprain
Stretching, small tears  Larger, but incomplete tear  Complete tear

*Jeffrey H Berg, MD

*Sheffield PhysioTherapy
Biomechanics of Ankle Sprains

- Occurs when a force causes a sudden inversion or eversion of the ankle joint
- The magnitude of the force can cause tendons to mechanically fail

*NYDN Rehabilitation*
*Steph Curry of the Golden State Warriors

*Amare Stoudemire of the New York Knicks
Injury Factors

*Doherty, et al*
Injury Factors Cont.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>p Value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) &lt;25 years and 25–34 years</td>
<td>0.78</td>
<td>0.48</td>
<td>0.37 to 1.65</td>
</tr>
<tr>
<td>(2) &lt;25 years and 35+ years</td>
<td>0.19</td>
<td>0.02</td>
<td>0.04 to 0.80</td>
</tr>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) &lt;169 cm and 170–180 cm</td>
<td>0.50</td>
<td>0.09</td>
<td>0.22 to 1.13</td>
</tr>
<tr>
<td>(2) &lt;169 cm and 181+ cm</td>
<td>0.92</td>
<td>0.84</td>
<td>0.43 to 1.97</td>
</tr>
<tr>
<td>History of ankle injury</td>
<td>5.60</td>
<td>&lt;0.001</td>
<td>2.61 to 11.94</td>
</tr>
</tbody>
</table>

*McKay, et al

<table>
<thead>
<tr>
<th>Variable</th>
<th>χ²</th>
<th>P</th>
<th>Risk Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance training program</td>
<td>4.513</td>
<td>.033</td>
<td>0.56</td>
<td>0.33-0.95</td>
</tr>
<tr>
<td>Age</td>
<td>0.007</td>
<td>.929</td>
<td>1.01</td>
<td>0.78-1.31</td>
</tr>
<tr>
<td>Level of competition</td>
<td>0.696</td>
<td>.404</td>
<td>0.76</td>
<td>0.41-1.42</td>
</tr>
<tr>
<td>Use of ankle support</td>
<td>3.821</td>
<td>.051</td>
<td>1.75</td>
<td>0.99-3.09</td>
</tr>
<tr>
<td>Height</td>
<td>0.564</td>
<td>.452</td>
<td>0.79</td>
<td>0.43-1.45</td>
</tr>
<tr>
<td>Weight</td>
<td>0.293</td>
<td>.688</td>
<td>1.03</td>
<td>0.90-1.18</td>
</tr>
<tr>
<td>Body mass index</td>
<td>0.495</td>
<td>.481</td>
<td>0.74</td>
<td>0.32-1.69</td>
</tr>
<tr>
<td>Leg dominance</td>
<td>1.490</td>
<td>.222</td>
<td>0.78</td>
<td>0.45-1.55</td>
</tr>
<tr>
<td>History of ankle sprain</td>
<td>7.891</td>
<td>.005</td>
<td>2.14</td>
<td>1.25-3.65</td>
</tr>
</tbody>
</table>

*McGuine, et al
Current Treatments in Sports Medicine

- Physical Therapy to increase strength
- Pain medication
- Taping Methods
- Braces
  - Lace-on-brace (Mikros, ASO, McDavid)
  - Stirrup brace system (Aircast)
  - Sleeve (McDavid)
  - Splint Brace (Zamst)
Treatments (continued)

*Foot First Podiatry

*ASO

*Aircast

*Physioworks

*Zamst

*McDavid
Current Challenges in Treatment

- Treatment  ≠  Cure
  - Re-injury occurrence is 5x more likely
- Braces restrict range of motion for the athlete
- Some braces have not been proven to be more effective than traditional taping methods
- Physical Therapy has limitations
- Observations have shown that after long-term brace use a dependency forms, though no in-depth studies have been done to prove this
Proposed Research

- No current studies have determined why players become dependent on their ankle braces
- What kind of muscle and physiological adaptations occur post-injury?
Goals

● In depth analysis of adaptations post-injury such as
  ○ Neurological
  ○ Muscle
  ○ Tendon
  ○ Gait and movement
Enroll subjects from the UT basketball team

- Previous ankle injury
  - Recent injury (≤2 months ago)
  - Injury >2 months
- No previous ankle injury*

*If the uninjured group is significantly larger than the injured group, we will disenroll some uninjured subjects from the study.
Materials and Methods cont.

- Follow subjects approximately 2 years post-injury
- Every 3 months the following will be measured:
  - Muscle-tendon strength
  - Parameters of the ankle muscles and tendons using imaging techniques
    - Length, width, diameter, & range of motion
  - EMG analysis of ankles
  - Data from subjects who wear ankle braces will be collected both with and without the brace
- Next Steps: Depending on the results of this study, further studies would be done to prove causation of muscle adaptations due to long-term brace use
Estimated Project Completion Time: 28 months
Potential Challenges and Pitfalls

- Enrolling a large enough sample size of subjects
- Gaining access to the needed imaging machines
- Possible data errors if a subject sustains any further injuries during the study
- Controlling for biological and lifestyle variation between subjects
Questions?
References


