VALIDATED KNEE BRACE FOR REDUCING ACL INJURY RISK DURING DROP LANDING

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Overview

- ACL Injury Prevalence
- Anatomy Of The Knee
- Injury Risk Factors
- Current Knee Brace Research
- Our Design
- Future Research
Over 200,000 ACL injuries occur annually [2].

About half receive surgery [1].

Around 70% are a result of non-contact [3].

67% occur in individuals 15-29 years old [1].

Females are 4-6x more likely to receive an ACL injury [4].

[1] Kevin E, Wilk, PT, DPT ASMI
<table>
<thead>
<tr>
<th>Least Expensive Care</th>
<th>Most Expensive Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Memphis, TN</td>
<td>1. San Jose, CA</td>
</tr>
<tr>
<td>$3,510</td>
<td>$20,162</td>
</tr>
<tr>
<td>2. Oklahoma City, OK</td>
<td>2. San Francisco, CA</td>
</tr>
<tr>
<td>$4,965</td>
<td>$18,577</td>
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<tr>
<td>3. Birmingham, AL</td>
<td>3. San Diego, CA</td>
</tr>
<tr>
<td>$5,118</td>
<td>$18,271</td>
</tr>
<tr>
<td>4. Houston, TX</td>
<td>4. Grand Rapids, MI</td>
</tr>
<tr>
<td>$5,193</td>
<td>$18,240</td>
</tr>
<tr>
<td>5. Austin, TX</td>
<td>5. Sacramento, CA</td>
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<tr>
<td>$5,573</td>
<td>$17,888</td>
</tr>
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<td>6. Providence, RI</td>
<td>6. Detroit, MI</td>
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<td>$5,867</td>
<td>$15,095</td>
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<tr>
<td>7. Miami, FL</td>
<td>7. Portland, OR</td>
</tr>
<tr>
<td>$6,313</td>
<td>$13,750</td>
</tr>
<tr>
<td>8. Rochester, NY</td>
<td>8. Indianapolis, IN</td>
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<tr>
<td>$6,407</td>
<td>$13,201</td>
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<td>$6,559</td>
<td>$13,157</td>
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<tr>
<td>10. Tampa, FL</td>
<td>10. Los Angeles, CA</td>
</tr>
<tr>
<td>$6,750</td>
<td>$12,535</td>
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</tbody>
</table>
Points of Interest

• Anterior Cruciate Ligament
  • Resist internal extension moments

• Posterior Cruciate Ligament
  • Resist internal flexion moments

• Medial Collateral Ligament
  • Resist internal adduction moments
  • Aka valgus

• Lateral Collateral Ligament
  • Resist internal abduction moments
  • Aka varum
• Max tensile strength
  • 2,160 (+/- 157) N [1]

• Contributes about 86% of the restraint to tibial anterior translation [1]

• Joint moments of 35-80 Nm during internal rotation moments at the knee are damaging. [2]

• 125-210 Nm during internal adduction are damaging. [2]

Kinematic Injury Mechanisms

Ankle
• Reduced dorsiflexion angle [1,3,6]
• Increased ankle eversion [2,5]

Knee
• Reduced knee ROM [1,3]
• Increased knee valgus [4,5]

Hip
• Internal rotation [1,3,5]
• Increased adduction [1,6]
Current Knee Brace Research

- Donjoy custom-fit, off-the-shelf, and athletic tape improved anterior stability without improvements in athletic performance [1].

- Non-braced, neoprene sleeve, knee brace with metal supports, and prophylactic knee sleeves showed no increase in athletic performance [2].

- Knee braces show a reduction in anterior draw with the greatest reduction using a knee-sleeve [3].

Knee Brace Design

- Standard compression sleeve.
- Posterior vertical strap to reduce knee extension.
- Medial and Lateral vertical straps to mimic the LCL and MCL function.
- Proximal and distal “cruciate straps” for increased stability.
Knee Moments Without Brace

258Nm Peak Knee Extension Moment

-55Nm Peak Knee Abduction Moment

-24 Nm Peak Knee External Rotation Moment
Knee Moments With Brace

158Nm Peak Knee Extension Moment
(258Nm Peak Knee Extension Moment)

-37Nm Peak Knee Abduction Moment
(-55Nm Peak Knee Abduction Moment)

-16Nm Peak Knee External Rotation Moment
(-24Nm Peak Knee External Rotation Moment)
• Designing specific braces to meet the needs of the individual.
• Testing the brace during multidirectional movements.
• Potential identification for sport/position specific needs.
• Gait analysis with brace for rehabilitation.
• Musculoskeletal modeling to detect possible changes in muscle patterns
• EMG research to detect changes in muscle potentiation.
Questions?