Semi-rigid braces reduce ankle inversion angles and velocities during highly dynamic turning movements in people with chronic ankle instability

Fuerst, P., Gollhofer, A., Wenning, M., Lohrer, H., Gehring, D.
Ankle Injuries

Upper arm/shoulder, 2.8%
Lower arm/hand, 9.4%
Knee, 10.6%
Hip/thigh/upper leg, 8.2%
Ankle/foot, 43.2%

Head/face/neck, 12.8%
Trunk, 7.1%

Table 4  Recurrent re-injury

<table>
<thead>
<tr>
<th>Grade</th>
<th>n</th>
<th>Regularly n (%)</th>
<th>Never n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>398</td>
<td>183 (46%)</td>
<td>215 (54%)</td>
</tr>
<tr>
<td>Grade II</td>
<td>128</td>
<td>69 (54%)</td>
<td>59 (46%)</td>
</tr>
<tr>
<td>Grade III</td>
<td>51</td>
<td>20 (39%)</td>
<td>31 (61%)</td>
</tr>
</tbody>
</table>

Verhagen et al., 1995

Borowski et al., 2008
What is CAI?

Chronic Ankle Instability

Mechanical Instability

Functional Instability

Medical examination

Questionnaire

MFI

FI

cf. Hiller et al., 2011a
What is CAI?

- Bone and joint characteristics
- Proprioception
- Force deficits
- Kinematics of movements
- Reflex responses
- Postural control

cf. Hiller et al., 2011b
How can we help?
Bracing: How much do we know?

Reduction of ankle injury numbers

\[\uparrow\]

Reduction of inversion angles & velocities

- Jump landing (Vanwanseele et al., 2014)
- Tilt platform (Gehring et al., 2014)

Unclear:
Role of braces in highly-dynamic, injury-relevant movements
Hypotheses

1. People with CAI exhibit increased inversion angles and velocities before, at and after foot strike.

2. Soft and semi-rigid braces reduce inversion angles and velocities in people with CAI.
Experimental Setup

CON vs. FI vs. MFI

- 180° turning – movements
- approach run: 4 m/s

Without and with brace

SOFT

SEMI-RIGID

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Data Analysis

2 factor ANOVA with repeated measures on factor CONDITION

Post-hoc t-tests

100ms before foot strike

at foot strike

maximum ankle inversion

Ankle Inversion Angle

Ankle Inversion Angle

Ankle Inversion Angle

Ankle Inversion Velocity
Results – Influence of GROUP

Without brace: No significant effects
Results - Bracing - Ankle Inversion Angle

No effects

No effects
Results - Bracing - Ankle Inversion Maxima

Reduced maximum inversion angles with the semi-rigid brace in both FI- and MFI-Group

Reduced maximum inversion velocities with the semi-rigid brace in FI-Group

![Graph showing reduced maximum inversion angles and velocities with different braces](image-url)
Discussion – Influence of GROUP

- Without brace: no significant differences between groups
- However: slightly higher maximum inversion angles and velocities in FI-group
Discussion – Effects of bracing

- Effects only for semi-rigid brace

  - Semi-rigid braces produce larger reductions of inversion angles on tilt platforms (Eils et al., 2002)

  - Reduction in injury numbers has also mainly been shown with semi-rigid braces (Dizon & Reyez, 2010; Verhagen & Bay, 2010)

The mechanical stiffness of a brace seems to be a critical factor in reducing inversion angles and velocities and in injury prevention.
Discussion – group-specific effects of bracing

- Only the FI- and MFI-groups showed decreased maximum angles and velocities

- With semi-rigid brace all groups show similar maxima

- External support has larger effects on injury numbers in people with a history of ankle sprains (Kaminski et al., 2013)

Especially people with chronic ankle instability benefit from bracing.
Summary

Semi-rigid braces seem to be effective in reducing maximum ankle inversion angles and velocities in people with FI or MFI, which may explain their capability to reduce injury numbers.
Literature


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