Influence of a valgus knee brace on muscle activation and co-contraction in patients with medial knee osteoarthritis


Genu Arthro

With Genu Arthro:

→ Muscle activity of rectus femoris (RF), lateral gastrocnemius (GL) and lateral hamstring (LH) decreased

Pre-activation phase:
- RF with neutral adjustment: 13.6% decrease
- GL with 4° valgus adjustment: 23.8% decrease
- GL with neutral adjustment: 16% decrease
- GL with 4° valgus adjustment: 17.7% decrease

Loading phase:
- GL with 4° valgus adjustment: 23.8% decrease
- RF with neutral adjustment: 18.5% decrease
- RF with 4° valgus adjustment: 16.3% decrease
- LH with neutral adjustment: 35.8% decrease
- LH with 4° valgus adjustment: 31.3% decrease

Early stance phase:
- GL with neutral adjustment: 16% decrease
- GL with 4° valgus adjustment: 17.7% decrease

Late stance phase:
- RF with neutral adjustment: 18.5% decrease
- RF with 4° valgus adjustment: 16.3% decrease
- LH with neutral adjustment: 35.8% decrease
- LH with 4° valgus adjustment: 31.3% decrease

→ Co-contraction ratios of the medial/lateral (M/L), flexor/extensor (F/E) muscle groups decreased

Loading phase:
- F/E with 4° valgus adjustment: 15.1% decrease
- M/L with 4° valgus adjustment: 12.3% decrease
- F/E with 4° valgus adjustment: 21.5% decrease

Late stance:
- M/L with 4° valgus adjustment: 12.3% decrease
- F/E with 4° valgus adjustment: 21.5% decrease

→ Co-contraction ratios of the lateral vastus/lateral gastrocnemius (VL/GL), lateral vastus/lateral hamstring (VL/LH) and medial vastus/medial hamstring (VM/MH) muscle pairs decreased

Pre-activation phase:
- VL/LH with neutral adjustment: 16.8% decrease
- VL/LH with 4° valgus adjustment: 5.9% decrease
- VM/MH with neutral adjustment: 19.6% decrease
- VM/MH with 4° valgus adjustment: 10.4% decrease

Loading phase:
- VL/GL with 4° valgus adjustment: 28.4% decrease

Rectus femoris muscle activity
Influence of a valgus knee brace on muscle activation and co-contraction in patients with medial knee osteoarthritis

Subjects: 12 patients (7 female, 5 male)
Mean age: 56.0 ± 4.6 yrs
Mean body mass: 80.9 ± 13 kg
Inclusion criteria: medial knee osteoarthritis from grade II to IV

The patients were not informed about the different adjustments of the orthosis.

### Study Design
Observational, comparative:

### Results

<table>
<thead>
<tr>
<th>Functions and Activities</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomechanics – Static measures</td>
<td>Biomechanics – Gait analysis</td>
</tr>
<tr>
<td>No orthosis</td>
<td>Data collection</td>
</tr>
</tbody>
</table>

**EMG**

**Amplitude parameters – Quadriceps group**
In the pre-activation phase of the gait cycle the muscle activity of the rectus femoris decreased by 13.6% with the neutral adjustment.

In the late stance phase the muscle activity of the rectus femoris decreased by 16.3% with the 4° valgus and by 18.5% with the neutral adjustment.

In all other phases of the gait cycle no significant changes were found for the rectus femoris, vastus lateralis and vastus medialis.

**Amplitude parameters – Hamstrings group**
The muscle activity of the lateral hamstring was significantly lower with the 4° valgus (31.1%) and the neutral adjustment (35.8%) in the late stance phase.

The muscle activity in the other phases of the gait cycle and of the medial hamstring did not differ significantly.

**Amplitude parameters – Gastrocnemii group**
The muscle activity of the lateral gastrocnemius was significantly lower in the loading phase with the 4° valgus adjustment (23.8%). In the early stance phase the 4° valgus (17.7%) and the neutral adjustment (16%) led to decreased muscle activity of the lateral gastrocnemius.

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The muscle activity in the other phases of the gait cycle and of the medial gastrocnemius did not differ significantly.

### Co-contraction ratios

#### Medial/lateral

The co-contraction ratios were 12.3% lower with the 4° valgus adjustment in the late stance phase.

Inter individual differences:

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>4° Valgus vs without orthosis</td>
<td>83%: decrease</td>
</tr>
<tr>
<td>Neutral vs without orthosis</td>
<td>50%: decrease</td>
</tr>
<tr>
<td>17%: increase</td>
<td>17%: no change</td>
</tr>
<tr>
<td>* of patients</td>
<td>33%: increase</td>
</tr>
</tbody>
</table>

#### Flexors/extensors

The co-contraction ratios were 15.1% lower in the loading phase and 21.5% lower in the late stance phase with the 4° valgus adjustment.

Inter individual difference was high.

#### Co-contraction ratios

<table>
<thead>
<tr>
<th>Muscle pairs</th>
<th>Loading phase:</th>
<th>Pre-activation phase:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral Vastus / lateral gastrocnemius</td>
<td>28.4% decrease (4° valgus)</td>
<td>5.9% decrease (4° valgus) and 16.8% (neutral) decrease</td>
</tr>
<tr>
<td>Lateral Vastus / lateral hamstring</td>
<td>10.4% decrease (4° valgus) and 19.6% (neutral) decrease</td>
<td>No significant differences for medial vastus / medial gastrocnemius and medial hamstring / lateral hamstring</td>
</tr>
</tbody>
</table>

### Satisfaction

Questionnaire about comfort, acceptance and subjective changes in gait

Perception of comfort during rest or gait did not differ significantly between the 4° valgus and neutral condition nor the perception of changes in gait and acceptance as treatment option.

* no difference (0), positive trend (+), negative trend (−), significant (++/−−), not applicable (n.a.)

**Author's Conclusion**

"In summary, significant decreases in muscle activity and co-contraction ratios were observed with the use of the knee brace in both adjustments, indicating a mechanical stabilization of the knee by the brace. The results of our study support the theory of a possible beneficial effect of knee braces in reducing knee loading by decreasing muscle activation and co-contraction levels. This additional mechanism of loading reduction in conjunction with the load reduction induced by the three-point-bending system of valgus braces could further contribute to avoid disease progression in patients with knee osteoarthritis." (Fantini Pagani et al. 2012)