Determining and implementing the individual normal posture in making a negative cast to produce orthoses for patients with neurological gait disorders

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Aim
The aim of this case study is to demonstrate how load distribution in the individual normal posture [1] of a standing patient while making a negative cast affects the efficacy of the final orthosis.

Material/Methods
- patient with right-sided hemiplegia (w., 48 years, ischaemic stroke)
- two dynamic Ankle Foot Orthoses (AFOs) with spring-hinge joints
- AFOs produced based on negative casts, taken in two different positions:
  1. in a gait related position: bodyweight more on affected leg, imitating mid stance (pos_gait AFO)
  2. in a stance related position: bodyweight distributed equally on both legs (pos_stance AFO)
- pressure distribution measurement over 45 gait cycles with each AFO
- video-based gait analysis
- comparison of both conditions, right side (Wilcoxon rank-sum test)

Results
<table>
<thead>
<tr>
<th>Step duration</th>
<th>Left, unaffected</th>
<th>Right, affected</th>
<th>Left, unaffected</th>
<th>Right, affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ms]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>pos_gait AFO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stance [%GC]</td>
<td>60.11 (± 4.80)</td>
<td>52.64 (± 8.01)</td>
<td>61.49 (± 6.48)</td>
<td>50.53 (± 4.11)</td>
</tr>
<tr>
<td>Swing [%GC]</td>
<td>39.89 (± 4.80)</td>
<td>47.36 (± 8.01)</td>
<td>38.51 (± 6.48)</td>
<td>49.47 (± 4.11)</td>
</tr>
<tr>
<td>Bipedal stance [%GC]</td>
<td>10.59 (± 13.11)</td>
<td>12.39 (± 2.97)</td>
<td>8.60 (± 5.89)</td>
<td>13.91 (± 4.39)</td>
</tr>
<tr>
<td>pos_stance AFO</td>
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</tr>
<tr>
<td>Stance [%GC]</td>
<td>61.27 (± 141.53)</td>
<td>38.73 (± 169.40)</td>
<td>31.27 (± 162.42)</td>
<td>26(± 163.83)</td>
</tr>
<tr>
<td>Swing [%GC]</td>
<td>38.53 (± 6.48)</td>
<td>61.47 (± 4.11)</td>
<td>49.47 (± 6.48)</td>
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</table>

Discussion
pos_gait AFO:
- body's centre of gravity aligning over the affected leg in mid stance (a)
- first and second bipedal stance phase equalised
- step width is reduced
- well suited for actively walking patients
- orthosis might provide an almost physiological gait

pos_stance AFO:
- body's centre of gravity tilting medially in mid stance and terminal stance (b)
- unphysiological pronation of the foot-lower leg-unit
  1. shortened swing phase
  2. prolonged stance phase
  3. increased step width
- for patients with an increased need for safety
- e.g. orthosis mostly for transfer purpose

Conclusion
Modifying the individual normal posture of a patient while making a negative cast might affect the gait. For an appropriate posture, consider the purpose of the orthosis and the mobility of your patient.

Keywords: Orthotics, neurological gait disorders, negative cast, individual normal posture

References