Critical Consideration of Possible Factors Influencing Joint Angles While Making a Negative Cast for Lower Extremities

The joint angles are a decisive influencing factor for the function of lower extremity orthoses. This new production technique helps to produce flawless orthoses.

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Example 1 before

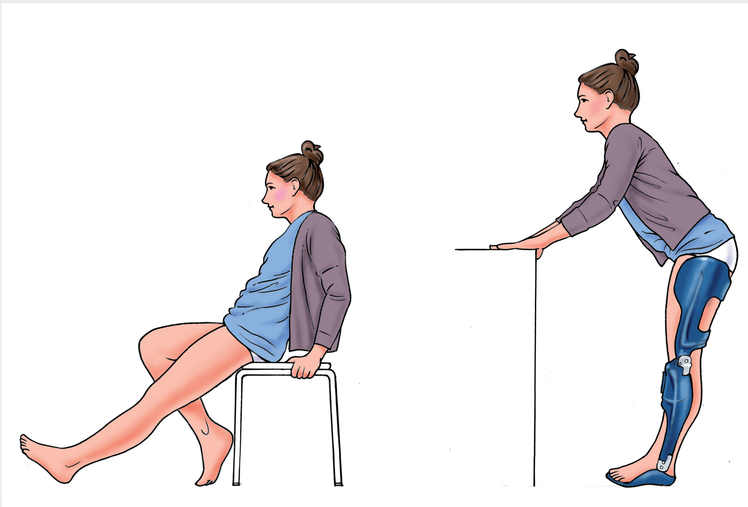

Figure 1:
Improper orthosis alignment resulting from an incorrect cast of an equinus contracture.

A common mistake at a restricted motion range of the upper ankle joint in dorsiflexion is a hyperextended knee. If the cast is made in this position (left), the patient subsequently stands like this (right).
A heel lift for compensating the equinus is required, at least. Yet, the knee position would still be unphysiologically hyperextended and make a physiological forward inclination of the tibia impossible.

The following points are influencing a casting technique:

- **Joint angles**
  the alignment of the foot, lower leg and thigh at all levels (see fig. 1 and 2)
- **Last pitch**
  considering the last pitch of the shoe as well as a possible leg length discrepancy
- **Leg contours**
  the casting of the leg contours
- **Anatomical points**
  the marking of the anatomical reference points for positioning the orthotic pivot points

Mistakes based on an improper negative or positive cast can only partially be corrected on a produced orthosis and require a lot of effort.

A professional casting technique is structured like this:

- **Joint angles**
  Casting the physiological leg position as necessity with regard to the fitting and function of the orthosis. Therefore, a digital angle control system has been tested which enables the reconstruction of the leg position defined while standing (see fig. 3 and 4).
- **Last pitch**
  The last pitch of the shoe is measured, adjusted to a new developed heel height/leg length compensation tool and placed below both feet.
- **Leg contours**
  A well fitting negative cast is produced with an optimised soft part compression of the leg. For this purpose, the leg is wrapped with cling film.
- **Anatomical points**
  The medial tibial plateau is felt and as well as the distal tip of the fibula marked.

Example 2 before

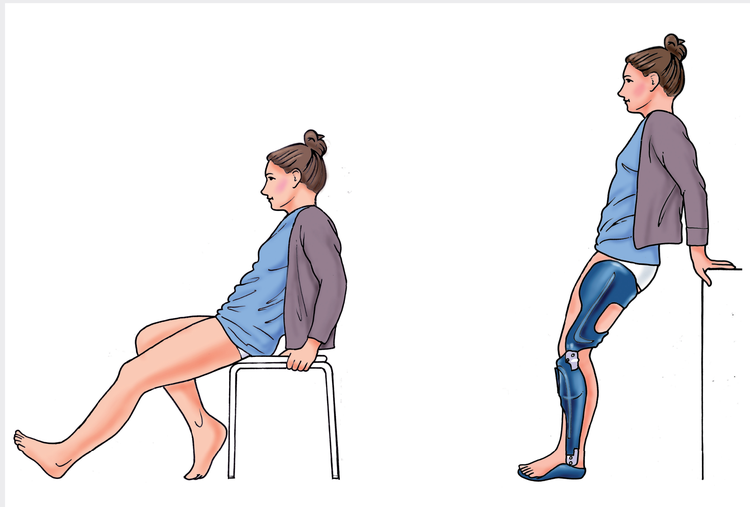

Figure 2:
Improper orthosis alignment resulting from an incorrect cast of a knee flexion contracture.

A common mistake at a knee flexion contracture is that the ankle joint is put in a cast with an outsized lower leg-foot angle (left). For the patient, the resulting orthosis makes even standing impossible (right).
The alignment could be corrected by filing off the dorsal stop or by a substructure for the heel. But for ankle joints the first is only partially possible and the last unnecessarily shortens the knee-securing forefoot lever.

Example 1 after

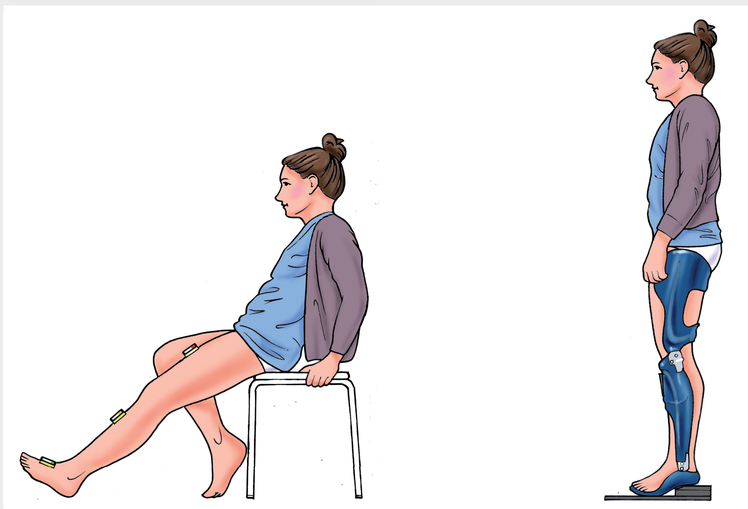

Figure 3:
Proper orthosis alignment resulting from a correct cast of an equinus contracture.

The angle of the knee now matches the angle of the ankle joint. And the functional height compensation, determined while defining the joint angles, is already integrated into the orthosis and/or the shoe. The result is a physiological forward inclination of the tibia and a knee flexion.

Example 2 after

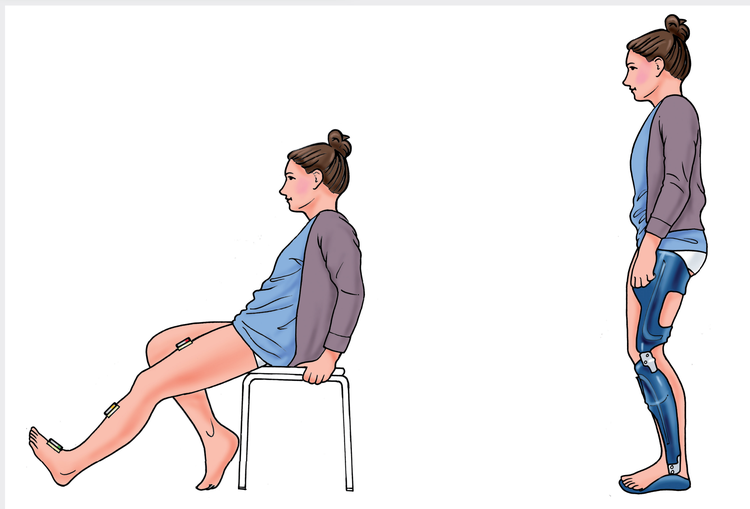

Figure 4:
Proper orthosis alignment resulting from a correct cast of a knee flexion contracture.

The angle of the ankle joint now matches the angle of the knee. Unlike fig. 2, the orthosis' alignment mat-ches the physiological position and thus prevents unnecessary further adjustments.

Conclusions

- the cast should only be made based on a detailed and reproducible patient history
- professional tools enable the reconstruction of a previously determined **individual** position in the negative cast
- considering the last pitch and a possible leg length discrepancy, the patient must only stand a very short moment and this position can be reconstructed again when the patient is sitting
- later corrections of the negative cast are possible
- correct joint angles are crucial for the orthosis' function
- **this is resulting in saving costs and time due to the unnecessity of extensive corrections**

Literature

D. Hohmann und R. Uhlig, „Orthopädische Technik," Stuttgart, Ferdinand Enke Verlag, 1990. P. 126f.
L. Lastring, „Folien: Orthetik der unteren Extremität," Dortmund, Bundesfachschule für Orthopädie-Technik, 2012. P. 121f.

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