

Technically controlling joint angles while making a negative cast as basis of functional orthoses for patients with neurological gait disorders

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Research Question: How can efficacy of an orthosis be improved by technically controlling the joint angles?

Introduction: Custom-made orthoses contribute to gait rehabilitation of patients with neurological gait disorders. Yet, a successful orthotic fitting is bound to certain conditions. As a consequence, a correctly adjusted dorsiflexion stop ensures a knee extension moment by triggering the forefoot lever in terminal stance [1] and enables activation of the knee joint. Attuned to gait phases, the exact locking and unlocking of a stance phase controlled orthosis crucially depends on correct joint angles. The individual normal posture each patient is positioned in while casting, determines the joint angles and should hence be planned and performed thoroughly.

Considering this, an innovative tool is introduced which enables transferring the patient's individual normal posture to the negative cast.

Material and Methods: The tool which was tested, consists of an operator device and three sensors - one for the foot, lower leg and thigh each. Each sensor detects its spatial coordinates and communicates with the operator device via Bluetooth. At this point, the absolute position of each sensor, the relative positions of two sensors to each other and therefore the joint angles are being calculated. This calculation's accuracy is within $<1^\circ$.

Results: The sensors are attached to thigh, lower leg and foot. In order to take last pitch and a potential leg length compensation into account, the patient is positioned in his individual normal posture on a heel height/leg length compensation tool (HLCT). The present angles are saved with the operator device. In the next step foot, ankle and lower leg are casted while the sensors remain attached to the patient's leg. Before the cast has hardened, foot and lower leg are put into the saved sagittal and frontal positions being positioned on the HLCT again. The operator device indicates when this position is reached (Fig. 1). This procedure is repeated when casting knee and thigh. As soon as the negative cast has hardened and been taken off, the sensors can also be removed.

Discussion: With the digital casting aid, joint angles of sagittal and frontal plane can be transferred to the negative cast. Casting technique is optimised by reproducing joint angles of the individual normal posture with maximum precision. Proceeding as described before, activation of the mechanical knee joints and the effects of a dorsiflexion stop can be quite improved. Further measurements need to be done.

References

- [1] Sabbagh D et al. 15th ISPO world congress proceedings, 2015.
- [2] Dünwald A et al. Orthop Tech 2015; 66(3): 42-46.

Keywords

Orthotics, neurological gait disorders, negative cast, joint angles, digital casting aid

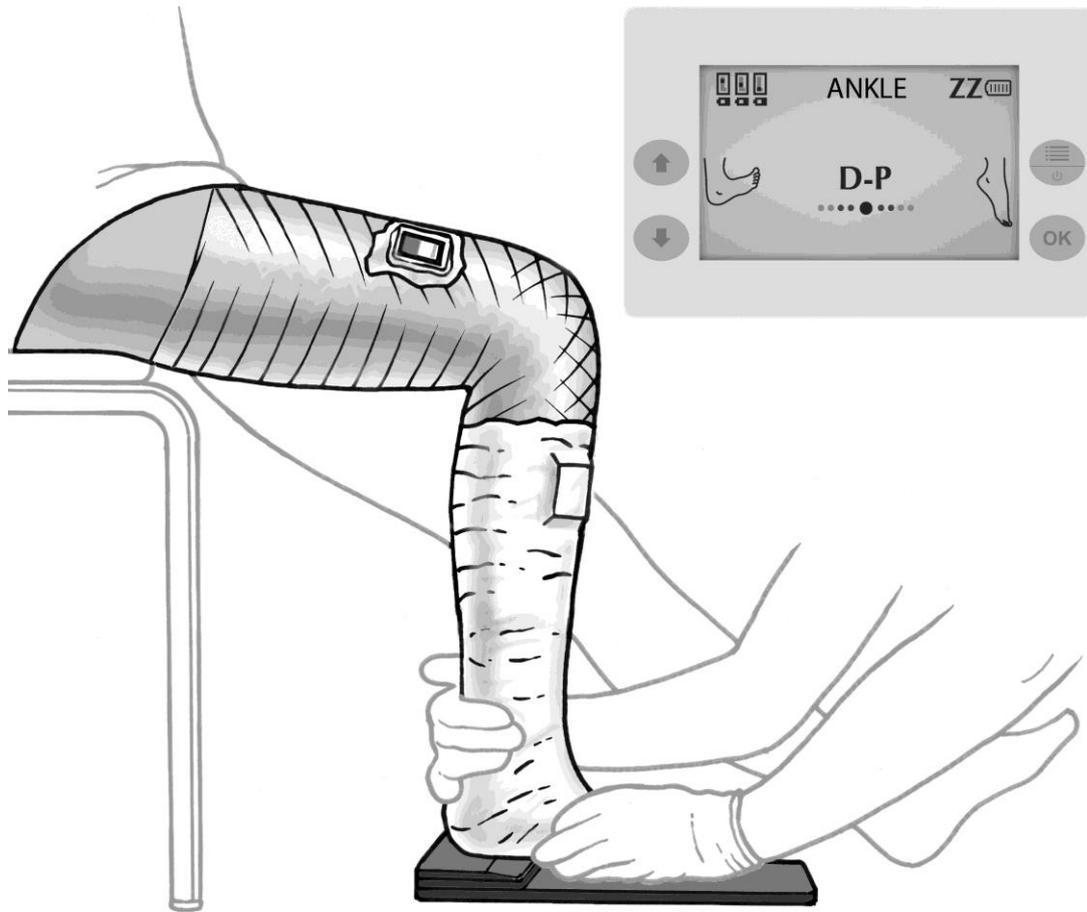


Figure 1) Positioning ankle on the HLCT after casting; controlling the sagittal angle by using the digital casting aid: Too strong plantar flexion = dot moves towards "P"; too strong dorsiflexion = dot moves towards "D".