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

D. Sabbagh*, J. Fior, R. Gentz

FIOR & GENTZ, Lüneburg, Germany

Research Question: How does load distribution in a standing patient affect functionality of the final orthosis while making a negative cast?

Introduction: Orthoses make a major contribution to gait rehabilitation of patients with neurological gait disorders; the negative cast being the basis for orthosis production and for a successful orthotic fitting. The load on the leg while making the negative cast determines the final orthosis' biomechanical properties. Thus, a negative cast can either be made in a gait-related normal posture (pos_gait) with load on the affected leg only or in a stance-related normal posture (pos_stance) with equal load on both legs [1]. A digital casting aid supports reproducing the resulting small differences of joint angles while making the negative cast.
The goal of this case study is to demonstrate the effects of both postures on gait parameters.

Material and Methods: A female patient with right-sided hemiparesis has been positioned in a pos_gait and in a pos_stance posture. A negative cast was made for each posture. With these negative casts, a dynamic ankle-foot orthosis (AFO) with adjustable ankle joint was built for each posture. Step duration [ms], duration of stance, swing and bipedal stance phase [%] as well as body alignment while walking 45 gait cycles with each AFO were determined. Video-supported gait analysis (Contemplas GmbH) and pressure distribution measurement (Paromed GmbH) were utilised. All parameters were compared using the Wilcoxon Signed-Rank Test.

Results: The p value of 0.003 shows a statistical difference in step duration between pos_gait-AFO (2766ms) and pos_stance-AFO (2624ms). With pos_stance-AFO, stance to swing phase ratio of the right body side is 50.6% to 49.4% including a first bipedal stance phase of 13.6%. With pos_gait-AFO, the ratio is 52.0% to 48.0% including a 12.3% bipedal stance phase (p=0.029). In mid and terminal stance, the body's centre of gravity aligns over the supporting leg with pos_gait-AFO and centres with pos_stance-AFO. Step width is reduced with pos_gait-AFO (Fig. 1).

Discussion: With a pos_stance-AFO, gait pattern is clearly approaching physiological gait. The shortened swing and prolonged stance phase is emphasised by body's centre of gravity aligning over the affected leg in mid and terminal stance. First and second bipedal stance phase assimilate. The pos_gait posture is well suited to produce orthoses for actively walking patients whereas pos_stance is aimed at patients with an increased need for safety. Further kinematic and kinetic examinations must be conducted to confirm these results.

Reference

[1] Dünnwald A et al. Orthop Tech 2015; 66(3): 42-46

Keywords

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

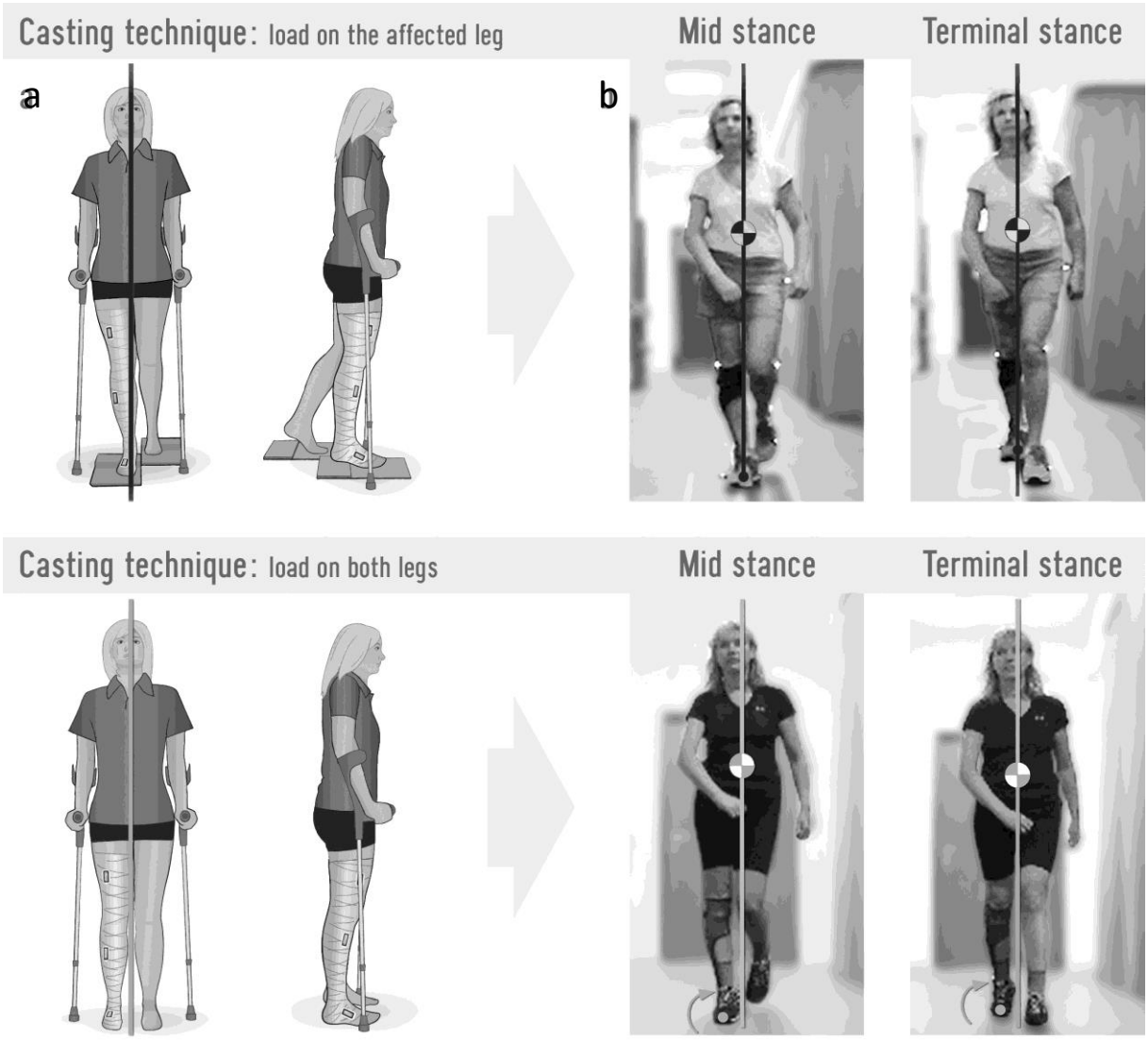

Figure 1 a) Casting technique in pos_gait (top) and in pos_stance (bottom) posture; b) effects of both AFOs on frontal plane gait pattern in mid and terminal stance.