

About the Necessity of a Dorsal Stop in KAFOs for Patients with Paralysis and Weak Plantar Flexors

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Background and Aim

Which indications may cause plantar flexor (PF) weakness?

- Spinal Cord Injury
- Spina Bifida or MMC
- Post Polio Syndrome and other indications

Too weak or prolonged PFs lead to additional instability while standing or walking. The goal of an orthotic fitting is to restore a physiological gait pattern in patients with PF weakness. A knee-ankle-foot orthosis (KAFO) can improve poor knee stability and muscular control. To ensure a most effective KAFO, it should be produced with a dorsal stop.

The aim is to point out effects of too weak PFs on gait patterns and to underline the need of a dorsal stop in case of PF weakness.

Materials and Methods

The biomechanics and gait patterns of healthy patients and a patient with weak PFs have been considered, including an evaluation of worn KAFOs.

Results

PF weakness causes inactivation of the forefoot lever (fig. 1). The activation of the forefoot lever is needed to achieve stable balance (tab. 1).

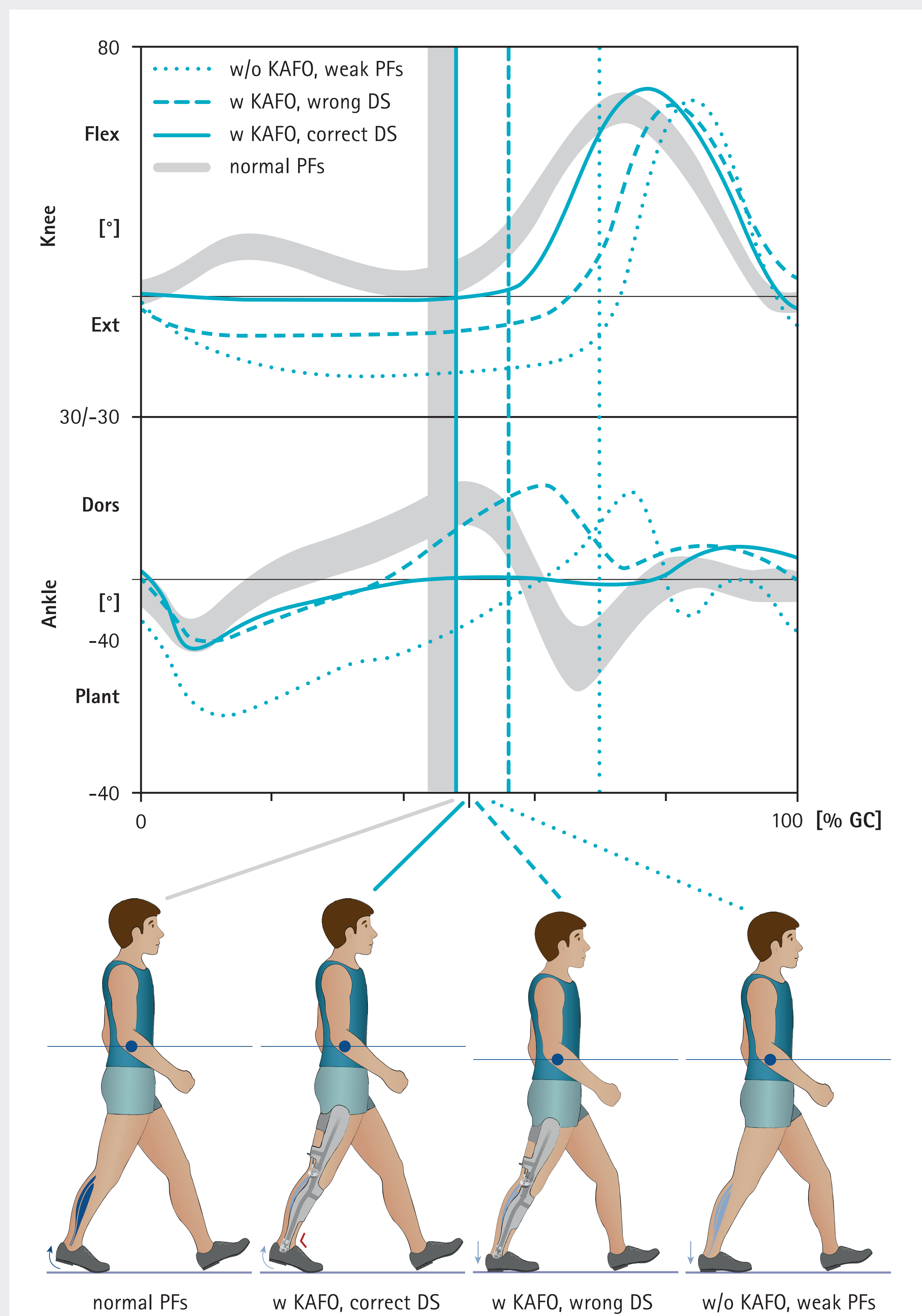


Fig. 1: Knee and ankle kinematics of a patient with PF weakness (dotted line) wearing a KAFO with a wrong dorsal stop (DS; dashed line) and with a correct dorsal stop (DS; solid line) compared to a physiological reference group (grey band). The vertical lines represent the heel off.

Results

Tab. 1: Effects of inactive and active forefoot lever on gait parameters to achieve stable balance.

	Inactive forefoot lever	Active forefoot lever
Security	decreased	increased
Step length	decreased	longer
Terminal stance		
Contralateral knee flexion	increased	physiological
Heel	remains on the floor	lifts from the ground
Body's centre of gravity	too low	correct

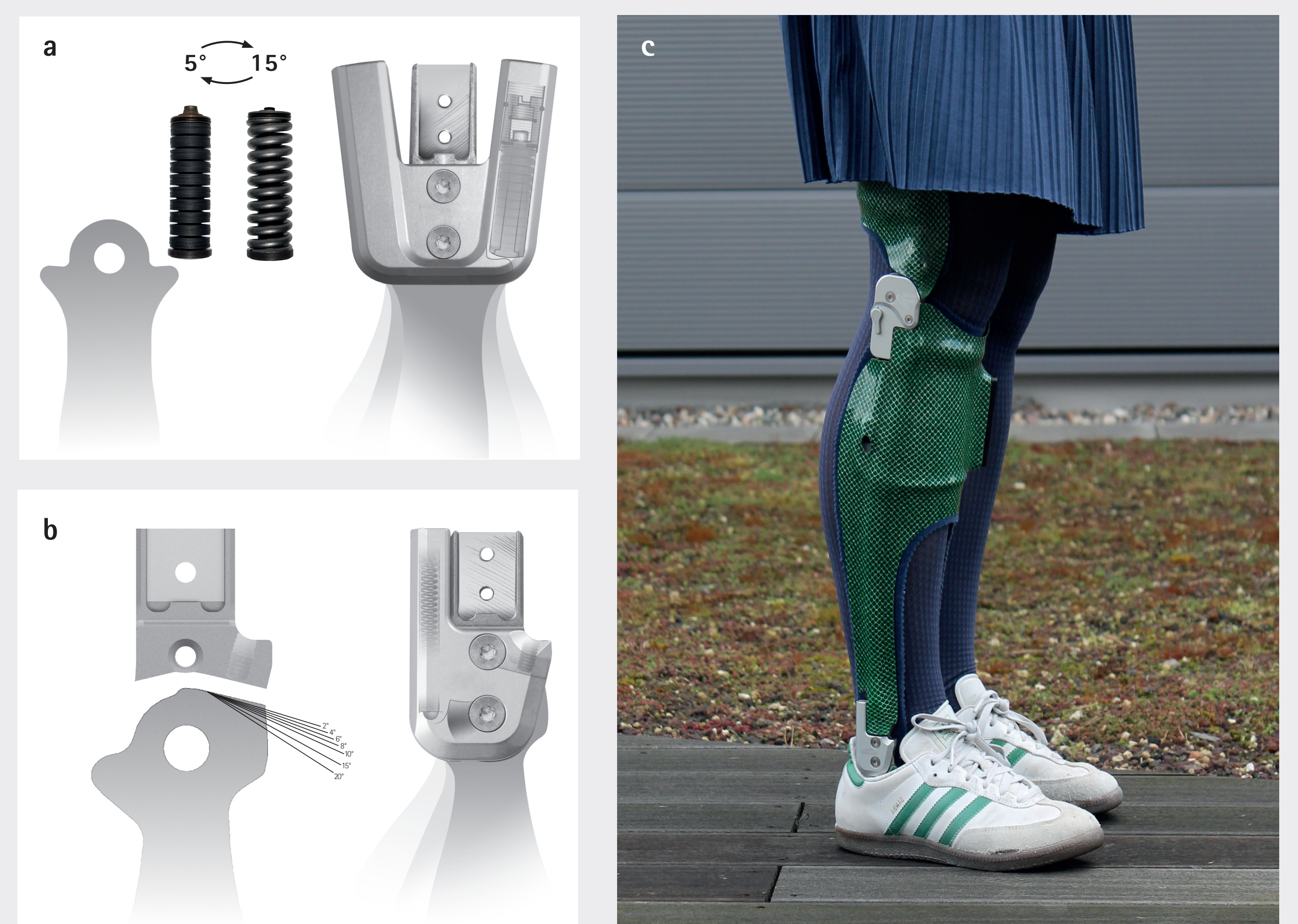


Fig. 2: Ankle joints with individually adjustable range of motion and dorsal stop in form of an ankle joint with an adjustable dynamic dorsiflexion stop (a) or in form of an ankle joint with an adjustable hard dorsiflexion stop (b) built in a stance control KAFO (c).

Discussion and Conclusion

Too weak or prolonged PFs can be responsible for an inactive forefoot lever. Therefore, KAFOs should always be produced using ankle joints with adjustable dorsal stops (fig. 2).

How to check the correct dorsal stop position on the work bench:

- 1) Press the KAFO with foot piece into the designated shoe.
- 2) Put the KAFO shell into dorsal stop position.
 - The line of gravity should pass through the middle of the femoral shell and ventrally ahead of the ankle joint.
 - The KAFO should stand unassisted.

How to check on your patient:

Stable balance efficacy can be visualised by slightly leaning the body's centre of gravity forwards and backwards (fig. 3 a).

For the visualisation of a correct dorsal stop in a dynamic situation check if your patient achieves a heel rise in terminal stance (fig. 3 b).

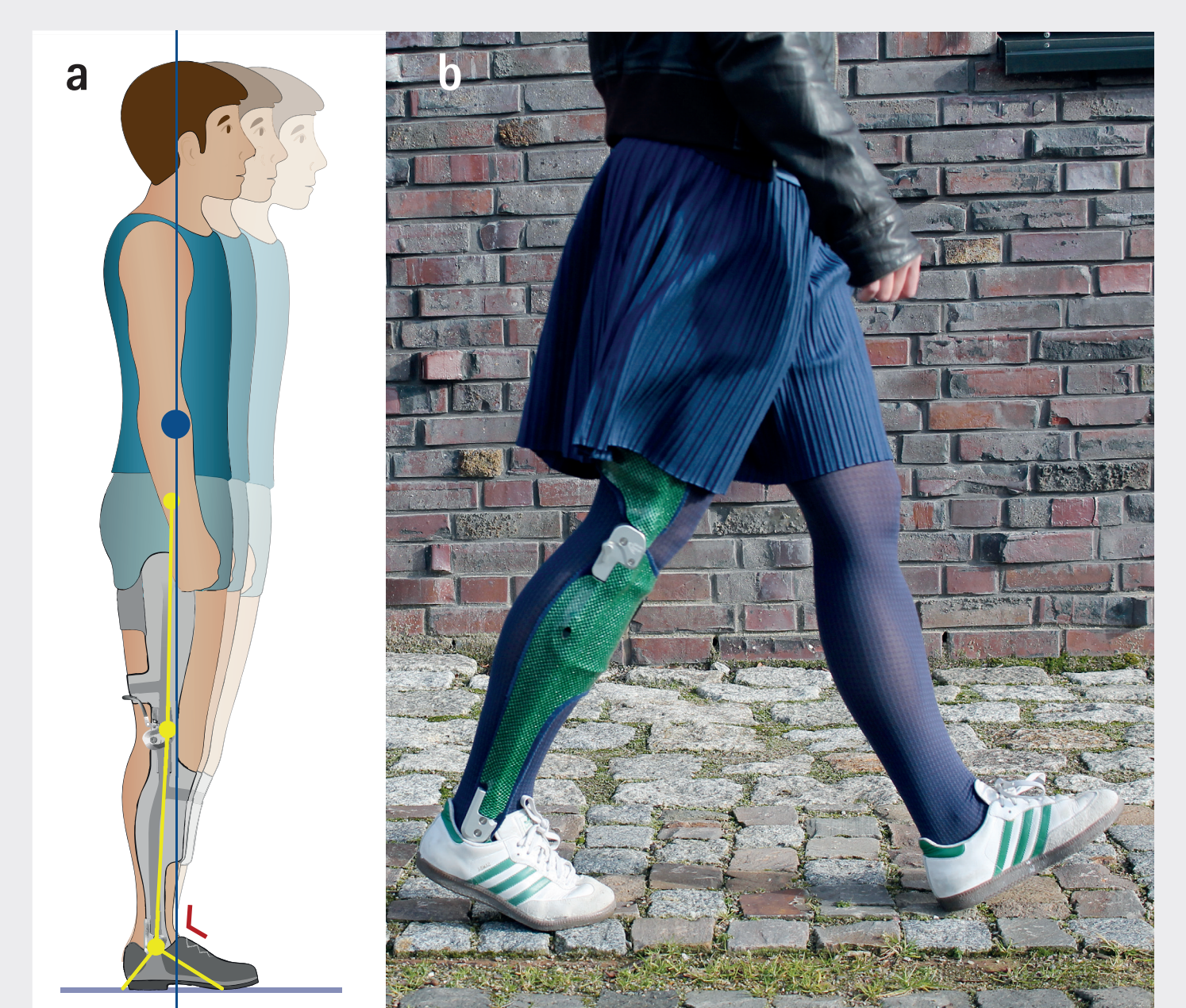


Fig. 3: Visualisation of the KAFO's dorsal stop on the patient in a static (a) and a dynamic situation (b).

Conclusion: A correctly adjusted dorsal stop is absolutely necessary for all orthoses for patients with paralysis and weak PFs to provide safety while standing and to improve gait pattern.

Literature

- [1] Beekmann C, Perry J, Boyd LA, Newsam CJ, Mulroy SJ. Topics in Spinal Cord Injury Rehabilitation. 2000; 5(4): 54–62
- [2] Ploeger HE, Bus SA, Brehm MA, Nollet F. Gait and Posture. 2014; 40(3): 391–398
- [3] Mulroy SJ, Eberly VJ, Gronley JK, Weiss W, Newsam SJ. Prosthetics and Orthotics International. 2010; 34(3): 277–292

This poster was presented at the 15th ISPO world congress in Lyon, France, 22nd - 25th June 2015.