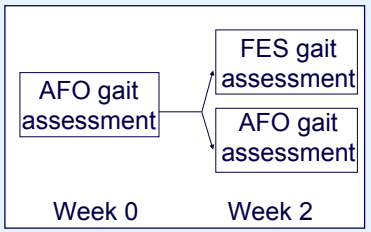
Peroneal stimulation in stroke patients with a drop foot may have more benefits than ankle dorsiflexion support to facilitate gait

Roos van Swigchem [1], Vivian Weerdesteyn [1,2], Alexander Geurts [1]
[1] Department of Rehabilitation, Radboud University Nijmegen Medical Centre, the Netherlands
[2] Sint Maartenskliniek Research, Development & Education, Nijmegen, the Netherlands

Gait in post-stroke hemiparesis is characterized by synergistic movement patterns that often coincide with loss of active ankle dorsiflexion (drop foot). We hypothesized that, as a treatment option for drop foot, functional electrical stimulation (FES) may be superior to the commonly prescribed ankle-foot orthosis (AFO), because it not only supports ankle dorsiflexion and eversion, but may also improve hip and knee movement of the affected leg during swing. As a result the ability to avoid obstacles is also expected to benefit from FES.

Participant
one chronic (21 months) stroke patient (male, age 60 years) regularly using a polypropylene AFO. FAC score 5; lower extremity Fugl Meyer scores 21%.

Gait assessments
- 1 baseline gait assessment using an AFO.
- 2 gait assessments (after 2 weeks of FES use) under FES-condition and AFO-condition.



Tasks of gait assessment
- 3 minutes of unobstructed treadmill walking at 2 km/h.
- 30 obstacle avoidance trials on a treadmill.

Data collection
- 3D recordings of heels, toes, and obstacle marker positions for computation of spatio-temporal characteristics
- goniometer joint angle recordings of hips, knees and ankles. Mean course (+ std) was computed over all strides during unobstructed walking. Phase angles (PA_j) were derived from low-pass (1 Hz) filtered joint angle deviations ($\Delta\varphi_j$) as follows:

$$PA_j = \arctan\left(\frac{\Delta\varphi_j}{d\Delta\varphi_j/dt}\right)$$

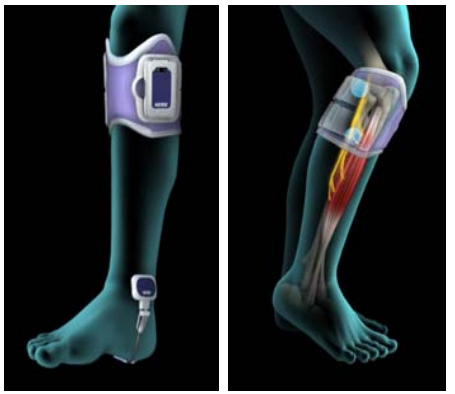


***Figure**: Wireless two-channel NESS L300™ FES device*

CONCLUSIONS

- FES improved hip- and knee-ROM, joint movement symmetry, and it reduced joint movement variability
- FES improved obstacle avoidance success scores from **0 to 69%.**

FES substantially improved the quality of gait and the ability to avoid obstacles

RESULTS:

With FES:
- Improved spatio-temporal symmetry
- Increased ROM hip/knee
- Reduced hip/knee variability
- Improved inter-limb phase relationship
- Large improvement of obstacle avoidance success rates

	Baseline	Week 2	
	AFO	AFO	FES
Unobstructed gait			
Spatio-temporal parameters			
Step length asymmetry (%)	10.6	10.7	9.8
Swing time asymmetry (%)	27	23.1	7.2
Joint movement parameters			
ROM paretic hip (deg)	23.1	26.1	32.3
ROM paretic knee (deg)	44.4	43.0	63.2
CoV paretic hip (%)	9.5	8.5	5
CoV paretic knee (%)	8.3	8.6	4.9
RPD-deviation hips (deg)	20.8	33.3	7.5
Obstacle avoidance			
Success rates (%)	8.7	0	69

ROM=range of motion; CoV=coefficient of variation; RPD-deviation= relative phase deviation: deviation from anti-phase relationship (=180º) between PA of the hips

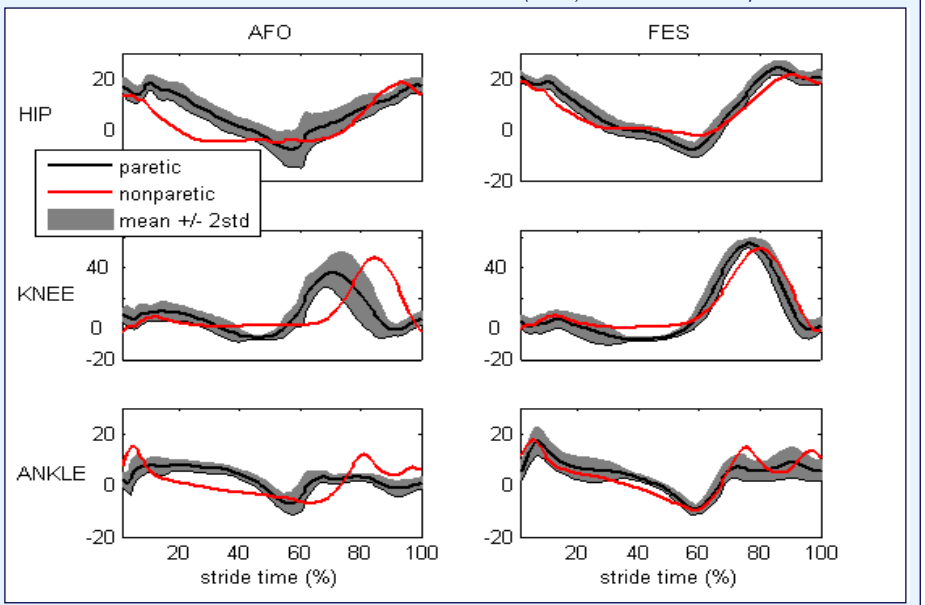


***Figure**: time-normalized course of joint angles during unobstructed gait*