Reference

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Therapeutic Experience on Stance Control Knee-Ankle-Foot Orthosis with Electromagnetically Controlled Knee Joint System in Poliomyelitis

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Products

E-MAG Control

Major Findings

With E-MAG and rehabilitation therapy:

→ Spatio-temporal data was improved

- 68.8% increased walking speed
- 23.0% increased cadence
- 38.0% longer stride length
- Longer step length on left (39.4%) and right (36.7%) side
- -17.7% decreased step width

→ Knee kinematic data was improved

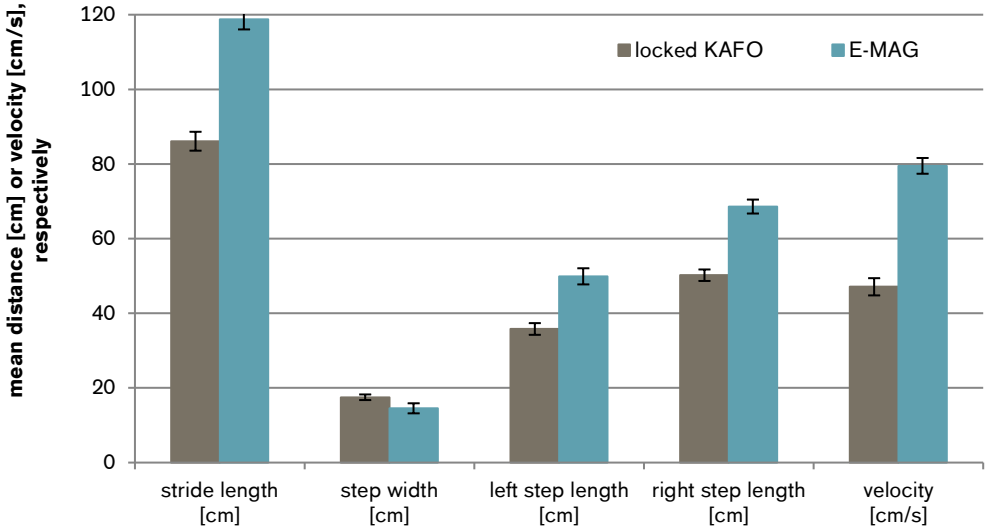
- during mid-swing phase an knee flexion angle of 59.15° was seen
- overall knee pattern of knee motion was closely matched to normal walking

→ Knee kinematic data was improved

- pelvic obliquity, hip abduction/adduction, knee flexion/extension, and foot rotation on the affected side were improved
- elimination of abnormal pelvic drop
- decrease in hip abduction indicating less circumduction

→ 11.3% less energy expenditure with physiological cost index (PCI)

Spatio-temporal data for locked KAFO and E-Mag after rehabilitation therapy

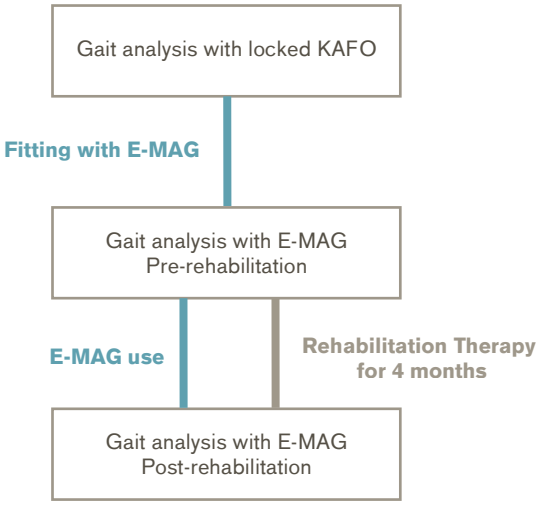


Population

Subject:	one man	
Age:	54 years	
Previous used orthosis:	KAFO with drop ring lock knee joint for 40 years	
Etiology:	Poliomyelitis	
Affected side:	left leg	
Manual muscle testing:	hip extension 2/5	hip flexion 2/5
	hip abduction 2/5	hip adduction 2/5
	knee extension 1/5	knee flexion 2/5
	ankle dorsiflexion 2/5	ankle plantarflexion 2/5
Range of motion:	hip: full RoM	
	knee: 20 – 0 – 150	
	ankle: 35 – 0 – 10	
Leg discrepancy:	2.5cm shorter left leg	
Deformities:	pes cavus and claw toes at left foot	
Gait pattern:	overuse of left pelvic girdle muscle with left pelvic hiking and circumduction during swing phase; severe genu recurvatum of left knee in stance phase	

Study Design

Case report:



Rehabilitation Therapy consisted of muscle re-education of the pelvis-hip-knee-ankle components, neuromuscular electrical stimulation therapy, strengthening exercises for the lower extremities, and balance training
Twice a week for 4 months

Results

Functions and Activities | Participation

Biomechanics – Static measures | **Biomechanics – Gait analysis** | X-Ray | EMG | **Functional tests** | Clinical effects | Satisfaction

Category	Outcomes	Results for E-MAG post-rehabilitation			
Biomechanics – Gait analysis	Knee flexion angle	During mid-swing phase the knee flexion angle was increased			
			Locked KAFO [mean (SD)]	E-MAG post-rehab. [mean (SD)]	difference
		Knee flexion angle [°]	10.26 (3.07)	59.15 (2.42)	48.89
		Use of E-Mag with rehabilitation resulted in an overall pattern of knee motion that closely matched that of normal walking.			
	Compensatory movements	Pelvic obliquity, hip abduction/adduction, knee flexion/extension, and foot rotation on the left side were improved			

Category	Outcomes	Results for E-MAG post-rehabilitation			
	Spatio-temporal data	**With E-MAG the mean velocity and cadence were faster; step-length and stride-length were longer; step-width improved**			
			Locked KAFO [mean (SD)]	E-MAG post-rehab. [mean (SD)]	change %
		velocity [cm/s]	47.1 (2.31)	79.5 (2.11)	68.8
		cadence [steps/min]	65.7 (2.07)	80.0 (2.23)	23.0
		stride length [cm]	86.1 (2.53)	118.8 (2.74)	38.0
		step width [cm]	17.5 (0.75)	14.4 (1.35)	-17.7
		left step length [cm]	35.8 (6.29)	49.9 (2.16)	39.4
		left stance [% cycle]	63.0 (3.35)	55.5 (3.95)	-11.9
		left swing [% cycle]	37.0 (3.35)	44.5 (3.95)	20.3
		right step length [cm]	50.2 (3.66)	68.6 (1.87)	36.7
		right stance [% cycle]	72.1 (1.72)	69.5 (1.11)	-3.6
		right swing [% cycle]	27.9 (1.72)	30.5 (1.11)	9.3
Functional Tests	Energy expenditure	The physiological cost index (PCI) improved			
			Locked KAFO	E-MAG post-rehab.	change %
		PCI	0.62	0.55	-11.29

Author's Conclusion

"The SCKAFO [stance control KAFO] improves gait kinematics, increases knee flexion during the swing phase, provides a more symmetrical gait, and requires less compensatory movement than the conventional, passive KAFO. However, there are three major problems with the SCKAFO designs: switching between the stance and swing phases is not smooth, the knee joint is locked during the stance phase, and the device does not assist in knee extension. In order to lock and unlock the knee joint, most SCKAFOs require patients to fully extend their knees, which results in a discontinuous gait and require the patient to attend to changing their gait. […] The E-MAG system is suitable for patients with higher mobility requirements who were previously unable or unwilling to obtain an adequately fitting orthotic for various anatomical reasons. An appreciable portion of the population using fixed-knee KAFOs has sufficient hip strength to benefit from a SCKAFO. […] After proper rehabilitation, the SCKAFO with E-MAG system improved our patient's gait by eliminating the abnormal pelvic drop during 52% to 69% of the gait cycle, and we could observe a decrease in hip abduction when he was walking with the SCKAFO with E-MAG, indicating less circumduction of his braced leg during the swing phase. The effect of knee flexion on the braced limb could be seen directly, with a reduction in pelvic obliquity and hip abduction suggesting a more efficient gait pattern overall. […] Compared with a locked knee, use of a SCKAFO with E-MAG appears to improve energy efficiency." (Kim et al. 2016)