Design and impact of the ankle foot orthosis on gait for the hemiplegic patients

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ABSTRACT

INTRODUCTION:
Two-thirds of those suffering a cerebral vascular accident (CVA) survive, with approximately half of those being left with physical incapacity [1]. Hemiplegic patients with cerebral vascular lesion, present a clinical picture which combines a variety of motor, sensory, visual and cognitive defects. These defects typically lead to disturbances of the gait cycle, characterised by changes in kinematic and kinetic parameters [2].

One of the clinical symptoms most commonly encountered in these patients is spastic foot characterised by a deficit of dorsi-flexion in stance and swing phase. One of the treatments currently used to treat spastic foot is botulinum toxin type-A (BoNTA) injections into the triceps surae [3]. This treatment is sometimes combined with wearing an ankle foot orthosis (AFO). The aim of this study is to quantify the effect of a BoNTA injection into the triceps surae of spastic foot patients and the impact of the combination of BoNTA and AFO.

METHODS:
Eight chronic hemiplegic subjects (6 males, 2 females; mean age: 47 years) who had suffered a cerebral vascular accident were enrolled. Gait was analysed using a motion capture system (Frequency 100Hz) and two force plates AMTI (Frequency 1000Hz). The trajectories of 29 markers placed on anatomical landmarks using the Helen Hayes marker set. Surface EMG was recorded during the kinematic data collection using 16 bipolar electrodes placed at specific sites. The kinematical parameters of the gait cycle were quantified (velocity, rhythm, length of step, stride, peak knee flexion in the swing phase, peak ankle dorsi-flexion in the stance and swing phase). For the kinetical parameters, the plantar flexion moment peak (PFMP) of the ankle in the stance phase, as well as the propulsive strength peak calculated from the strength of reaction on the postero-anterior axis, were quantified.

RESULTS SECTION:
Assessment of the articular kinetic parameters when treated using BoNTA-alone or in combination with AFO showed that peak ankle dorsi-flexion in swing phase was significantly increased by wearing an AFO (Fig.1). However wearing AFO did not modify the increase of peak knee flexion during swing phase and of peak ankle dorsi-flexion during stance phase induced by BoNTA-alone. Regarding kinetic parameters, AFO induced a significant increase of the Peak of Plantarflexion Moment.

![Figure 1: Value of Peak dorsiflexion in degrees.](image)

DISCUSSION:
The results indicate that AFO treatment appear to confer additional benefits to the therapeutic treatment of the spastic foot. BoNTA injection into the triceps surae improves the gait of patients by increasing ankle dorsiflexion in the stance phase, as well as the PFPM. The utilisation of AFO encourages dorsiflexion of the ankle during the swing phase and does not impede the benefits attained by use of BoNTA in the support phase. Taking into account the mechanics of the lower limbs as a whole, the results obtained during the present study permit us to develop the new AFO prototype and to test it with several subjects. This system improves the knee and ankle movement during the different walking phases.

REFERENCES: