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Title
Active ankle-foot-orthosis for ALS rehabilitation

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Summary
Active Ankle-foot-orthosis (AFO) prototype for gait improvement, muscle activity and range of motion. Anterior model presenting pneumatic cylinders and an electronic control. It’s necessary to reduce the components weight and to use it in a sample of subjects in physical rehabilitation process

Introduction
Amyotrophic Lateral Sclerosis (ALS) is a progressive neurodegenerative and fatal condition, caused by the degeneration of the motor neurons, leading to the reduction of the voluntary movements. Due to the disease’s progression, subjects start presenting reduction of lower and upper limb strength and are advised to use ankle-foot-orthosis or boxias to enhance their functional performance. The clinical conditions may cause weakness of the lower limb muscles, lower muscle tone, difficulties in perform a normal gait leading to the use of different ankle-foot-orthosis models. However, it has been shown that the traditional models lead to muscle atrophy, higher energy consumption, fatigue and difficulty in rehabilitate the function. The purpose of this study is to develop the proof of concept of an active AFO adjusted for ALS users

Methods
The model presents an anterior structure, controlled by pneumatic and electronic systems. The device development includes casting using plaster bandages, cast modification, moulding and pneumatic and electronic components assembling. The AAFO solution has an anterior structure, articulated with two pneumatic cylinders for shock absorption and foot movement using the pneumatic pressure inside. The system can be locked or unlocked using remote control to activate a solenoid valve

Results

After casting modification, thermoplastic is moulded as an anterior peace of the orthosis. It is divided in two parts, and the limits are set in superior (below the head of the fibula), lateral (around the malleoli) and inferior (metatarsal heads). The leg and foot parts are linked using pneumatic cylinders that are connected to a solenoid valve. The air is locked and unlocked in the cylinder according to the solenoid command to control or relief tibiotarsi movement and the distal part of each cylinder presents an air regulator to regulate the shock absorption effect

Conclusion

In physical rehabilitation subjects, there is a progressive loss of muscle strength, so the new device is a good solution to promote gait, autonomy, to reduce muscle weakness, and general quality of life. The development of this prototype is important for the development of new active solutions in AFO and higher clinical staff change of device regulation during rehabilitation process. In the future, it is necessary to reduce the component dimensions, to perform biomechanical testing and to apply it in a clinical trial

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