A New Paradigm of Ankle CPM Machine: A Portable Two Axes Ankle CPM Machine Using Linear Actuators

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Statistically, the number of patients with chronic ankle disease due to ankle sprains are continuously increasing, but the rehabilitation environment is not being improved. Existing CPM machines for ankle rehabilitation are heavy, expensive and not portable, which disturbs continuous treatment. The purpose of this research is to develop a portable ankle CPM machine with two axes using linear actuators. In order to imitate the actual ankle movement, we designed and manufactured an ankle CPM machine with skewed two axes like real human ankle. We derived a conversion formula that calculates the length of linear actuator during the ankle movement. Using this, the torque and length range of the actuator were calculated, and the actuator was selected. The experimental and theoretical values of the length of the linear actuator were compared during one cycle of human gait movement. As a result, the two values showed an error rate within 1.3%. Through this, the controllability of the ankle CPM machine was verified. Additionally, we measured the torque to verify the stability and effectiveness of the CPM machine by using two load cells attached to each linear actuator. As a result of comparing two values, the measured value and actual value, the measured value was much similar to the actual torque value. Through the two verifications above, we confirmed that our device is suitable for the CPM machine. Our research is meaningful as we propose a new method of ankle CPM machine that can help a lot of people around the world. Our CPM machine is more effective than other devices. It is light, small, portable and inexpensive. Nevertheless, the device applies enough torque. We expect that our ankle CPM machine will help patient’s rehabilitation and give them hope all over the world.

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