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A Clinically Relevant Exoskeleton Robot for Elbow Spasticity in Hemiparetic Stroke Patients

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Objective

In this paper, we propose a new elbow exoskeleton robot and investigate the effect of the robot on spasticity for patients with hemiparesis after stroke.

Methods

The robotic device was designed to have clinically relevant features for spasticity management; accuracy, sufficiency, and compliancy. An assessment using the robot was processed for patients with each Modified Ashworth Scale (MAS) scores to verify the gaugeability. Twenty two participants with hemiparesis following stroke who had severe spasticity of the affected elbow were recruited and randomly assigned to a intervention group or a control group. The stretched state was maintained for 20 minutes/session, and the program on intervention group was performed for 5 days/week for 2 weeks. Spasticity of the affected elbow was assessed three times with intervals of a week (once [Pre] before and twice [post-1, post-2] after starting the static stretching program) using the MAS.

Results

The strong positive correlation was observed between the MAS measured by therapists and the maximum torque value measured by robot ($r=0.75$, $p<0.05$), and the correlation between MAS and gradient A ($r=0.71$, $p<0.05$). Significant differences were observed in mean MAS (Pre [3.29±0.55] and Post-2 [2.25±0.89], $p<0.05$) and in maximum torque (Pre [11.22±3.62] and Post-2 [9.27±3.92], $p<0.05$).

Conclusion

We found that the stretching program using robot could effectively relieve spasticity for patients with severe spasticity. Moreover, this robot system could be used as a measurement tool to identify the spasticity accurately based on the high correlation.

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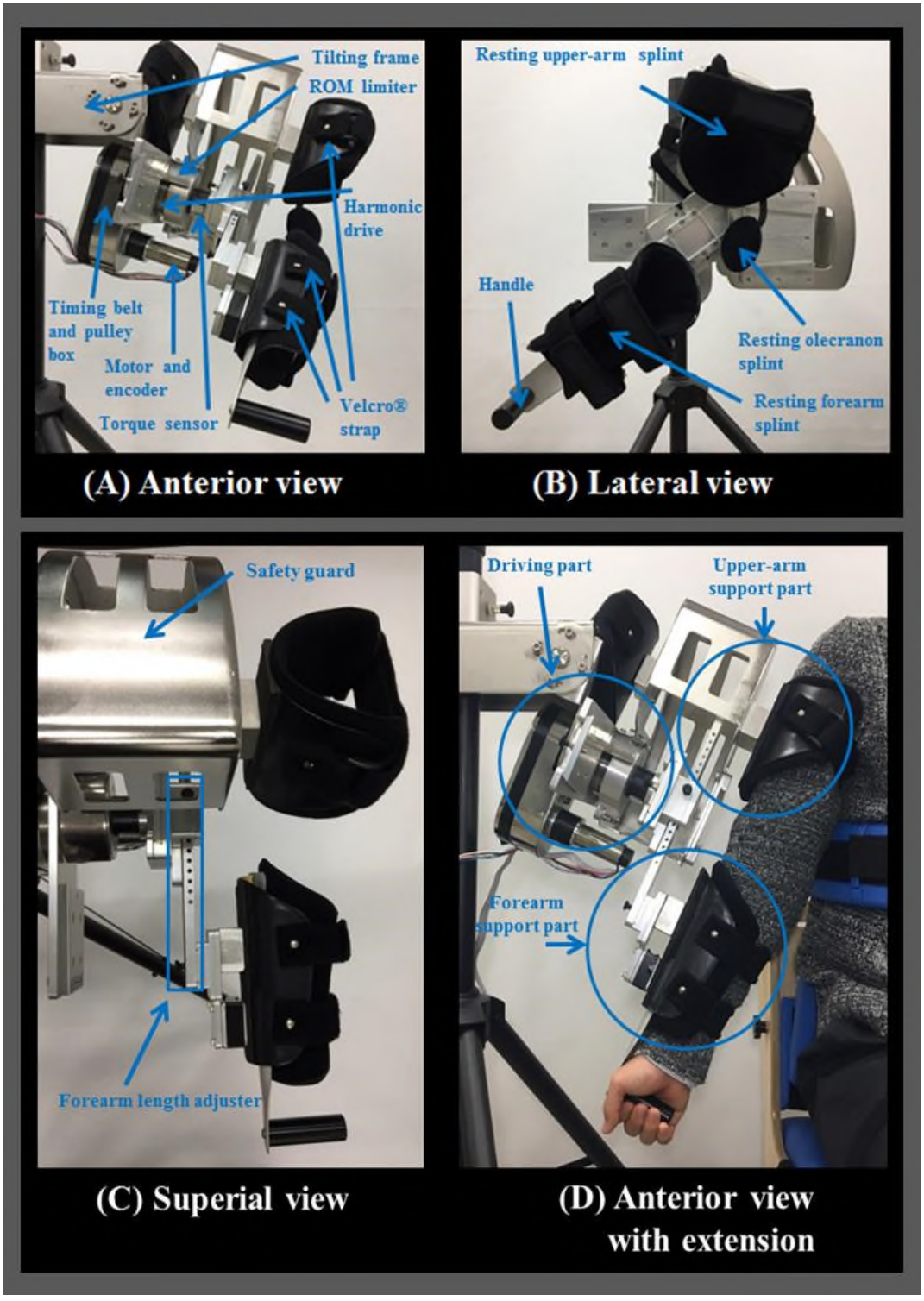

Exoskeleton robot, indicating (A) anterior view of exoskeleton robot that illustrates driving part mainly, (C) lateral view of exoskeleton robot that contains splints, (B) superial view, (D) anterior view with extension of upper limb.