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Therapeutic effectiveness depending on the composition of upper limb robotic therapy in tetraplegia

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Introduction
Upper limb robotic therapy has been shown to be a effective tool for rehabilitation for individuals with spinal cord injury(SCI). While there are some studies that have determined the effectiveness of upper limb robotic therapy with different frequencies and duration, there are few researches on which composition of training is effective in improving motor function. Therefore, this study is conducted to determine which composition of upper limb robotic therapy is more effective in recovering the upper limb function of spinal cord injury patients, simple repetitive training or training to elicit complex movements.

Method
A total of 16 American Spinal Injury Association Impairment Scale(AIS) B,C,D tetraplegic patients were randomly assigned to one of the two training protocols and received robotic therapy with upper limb robots called Armeo power(Hocoma, Switzerland). Although the contents of training were the same in both protocols(shoulder flexion/extension, shoulder abduction/adduction, and elbow flexion/extension, 10 minutes each), one was composed of repeating each movement in order and the other was composed of combining the above movements by performing tasks, such as games. All patients trained for 30 minutes per session, 3 times a week, for a total of 5 weeks. The assessment was conducted before the training and at the end of the training. To assess the upper limb movement, we placed a circle with a radius of 20cm in front of 85% of the patients' extended arm length in their chair position. Participants performed touch the markers on the center, 6, 12, 9 o'clock, and 3 o'clock of the circle in order. Movement time, mean velocity(MeanV), maximal velocity(MaxV), ratio between mean velocity and max velocity(MeanV/MaxV), mean arrest period ratio, and time to velocity peak were evaluated. In addition, manual muscle test(MMT), modified ashworth scale(MAS), Korean version of spinal cord independence measure-3(KSCIM-3), the goal attainment scale(GAS), the capabilities of upper extremity(CUE) and upper limb pain were evaluated.

Result

participants performed simple repetitive training and 9 participants performed complex movement training. After training, both groups have significantly improved MeanV, MaxV and GAS scores. Significant improvements in MeanV/MaxV and mean arrest period ratio, which are represented by smoothness of movement, were seen in the complex movement training group. There were no significant differences between the two groups in the above indices. Movement time, time to velocity peak, MMT, KSCIM-3, CUE, MAS and upper limb pain were not significantly improved and no difference was seen between the two groups.

Conclusion

Upper limb function has improved overall by using any composition of training. While there was no significant difference, it is suggested that complex movement training may be more effective in improving smoothness and coordination of movement than simple repetitive training.
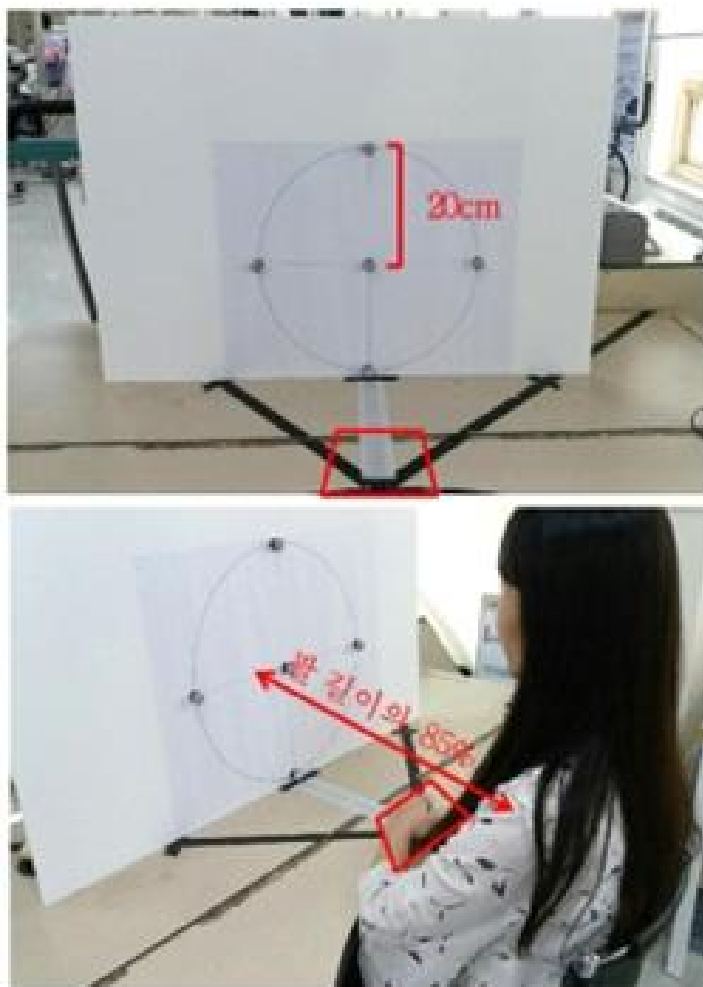

Figure 1. Armeo Power

Figure 2. Setting for assessment of upper limb movement