Human factors analysis of a single curved shoulder arc for stroke patient

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Introduction

Conventional rehabilitation instruments are commonly seen in the department of rehabilitation of the hospital. Occupational therapists still help patients restore their physical function and return to work by using these conventional instruments. They adapt the training intensity by their experiences. However, errors could happen, even for senior therapists, while they deal with patients in a heavy duty. Also, errors could happen in younger therapists (Cordo et al., 2013; Masia, Krebs, Cappa, & Hogan, 2007; Volpe et al., 2000). Therefore, an ergonomic analysis for the conventional rehabilitation instruments is needed for avoiding the re-injury and as a reference by documenting the influences on human musculoskeletal loadings. The purpose of this study is to investigate the effects of the commonly used instrument in clinics, single curved shoulder arc (SCSA), on weight shift for stroke patients.

Method

Ten stroke patients were recruited. The criteria for selection were as follows: (1) unilateral hemiplegic stroke patients capable of following simple verbal instructions; (2) ability to walk on a level surface and to walk up and down stairs independently or under supervision with or without assistive devices (handrail or cane) and without wearing an AAFO; and (3) no systemic or local medical problems, other than stroke, that might affect walking mobility. Four exclusion criteria were established: (1) clinically significant visual impairment; (2) unilateral neglect; (3) aphasia; and (4) the ability to voluntarily dorsiflex the ankle against gravity. Their average weight was 60.6 (±9.5) kg, and their average height was 168.4 (±8.8) cm. Each subject was asked to perform three different width of SCSA with the unaffected hand including 3 times and
4 times of shoulder width in standing posture. The Vicon Motion System (Vicon 460, Oxford, UK) with six 120 Hz cameras and two forceplates with 1080 Hz was used to measure relative joint positions. The weight shift, kinematics and kinetics were calculated and analyzed using laboratory-developed motion analysis procedures. A repeated one-way ANOVA was used for statistical analysis with a significance level $p<0.05$. Before the experiment, all participants provided informed consent, and the protocol was approved by the Institutional Review Board.

Figure 1. Experiment setup of the motion analysis with a single curved shoulder arc for stroke patient

Results

Weight shift

Vertical force of weight shift of 4 times shoulder width of SCSA was significantly greater than that of 3 times width of SCSA ($p<0.05$, fig 2). Anterior/posterior and medial/lateral shear force of weight shift were not significantly different between different shoulder width of SCSA.

Figure 2. Peak weight shift in three direction for stroke patient performing SCSA with the
The finished time of 4 times shoulder width of SCSA was significantly greater than that of 3 times width of SCSA (p<0.05, figure 3).

Figure 3. Finished time for stroke patient performing SCSA with the unaffected hand in standing posture

The shoulder angle of 4 times shoulder width of SCSA was significantly greater than that of 3 times width of SCSA (p<0.05, figure 3). The shoulder angle for 4 times SCSA groups was 91 degrees.

Figure 4. Maximal shoulder angle for stroke patient performing SCSA with the unaffected hand in standing posture

The width of SCSA can significantly affect weight shift, finished time and shoulder angle for
stroke patients. The more width of SCSA the more challenge for stroke patient. Therapist should pay more addition to the use of different width of SCSA.

