Effect of Physical Therapy on Joint Angle of Hemiplegic Patients during Standing-up Motion

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Abstract—Stroke patients improve motor function by the rehabilitation of the physical therapist (PT). We analyzed the effect of rehabilitation intervention on standing-up motion of stroke patients. We measured the standing-up motion using the motion capture system and calculated the joint angle based on the body trajectory. The results show that patients with PT’s intervention do not bend their upper body as much as patients do without PT. This is caused by PT intervention which teaches patients the timing of lifting their buttocks.

I. INTRODUCTION

Many stroke patients have paralysis and the declining motor function. They improve motor function by the rehabilitation of the physical therapist (PT) or the rehabilitation robot [1].

This research focuses on the human standing-up motion since it is an important daily activity. For effective rehabilitation using the assistive device, the assist trajectory should be considered. Therefore, this study investigates the influence of PT’s intervention on the body trajectory, especially the joint angle, during rehabilitation of the hemiplegic patient’s standing-up motion.

II. METHOD

Figure 1 shows a PT who intervenes the patient with standing-up motion at a rehabilitation hospital. We reported that a PT mainly intervenes in the distal thigh and pelvis before the patient lifts the buttocks off a seat and a PT teaches the patient the timing of lifting the buttocks [2].

This study measures the joint angle of the patient with the PT’s intervention and investigates the effect of the intervention on the body trajectory. For calculating the joint angle, we first fit the musculoskeletal model to the physique of the patient in a stationary state. Then, we calculate the least squared error between the positions of markers and the model coordinates and determine the joint angle at which the error becomes minimum. The joints are calculated for waist, hip, knee and foot joints. The center of mass (CoM) is calculated based on the joint angle.

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Fig. 1 Intervention of Physical Therapist

Twelve hemiplegic patients (ten male and two female, average age is 56.0 years old) and two PTs participated in the experiment. The Fugl-Meyer score in lower extremity was 23.6 ± 6.0. Patients stood up on their own ten times and stood up with intervention by the PT ten times. Patients’ motion was measured by the motion capture system (Motion Analysis Corp.). The joint angle and CoM was calculated using SIMM (Musculographics Inc.).

III. RESULTS AND DISCUSSION

The results of CoM show that the timing of switching the CoM moving upward become earlier by the intervention of PT. Furthermore, when a PT intervenes with patients, the minimum angle of hip joint was higher than that without PT. The value of the paralysis side and the other side when there was no intervention by PT were 67.8 ± 11.1 deg and 63.6 ± 9.6 deg, and when there was intervention, those were 68.8 ± 9.4 deg and 66.0 ± 7.8. From these results, it can be seen that patients do not bend their upper body deeply when PT intervenes. This may be caused by that PT’s hand which intervenes on the posterior pelvis of patients fixed the pelvis posture to avoid hyperflexion.

IV. CONCLUSION

This study investigated the intervention of PT to the standing-up motion of hemiplegic patients. It was showed that patients tend to stand up without deeply bending their upper body because PT intervened and taught patient the timing to lift buttocks off. In the future study, the assist device for standing-up motion will be developed. That device will take advantage of the PT’s skill we analyzed and support the hemiplegic patient to stand up.

REFERENCES
